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Submarine Cable Telegraphy.

FROM the earliest days it has been the function of the electrical engineer to overcome apparently insuperable difficulties in the development of his various projects, and continually to improve the efficiency of his apparatus: from time to time a limit seems to be attained beyond which further progress is either technically impossible or economically impracticable—but out of the boundless resources of physical science a key is ultimately forthcoming which opens the door to a new avenue of invention and progress.

History is full of such episodes in almost every branch of the electrical industries. Sometimes the solution is ready in advance of the need for it, as in the case of the loading of telephone lines, which was worked out on paper by Oliver Heaviside long before the problem of long-distance telephony became acute; in other instances the difficulty was felt first, and led to a search for a way round it—a recent instance being the troubles experienced in the working of underground cables at pressures over 30,000 volts.

One of the most striking examples of the latter order is the case of the long submarine cable. With extraordinary enterprise our forefathers laid the first cables across the Atlantic Ocean some 60 years ago, persevering in the face of repeated disheartening failures until they succeeded in establishing permanent communication with the New World; methods of signalling were gradually improved, up to a point beyond which it seemed impossible to go without enormous expenditure, and until the war period, though most ingenious instruments were devised, and improved methods of operation were adopted, the speed of transmission was limited to less than 300 letters a minute in each direction. But research came to the rescue—and with the American invention of "Permalloy" (which was followed shortly afterwards by the British alloy, with similar properties, called "Mumetal"), providing a means of inductively loading a cable throughout its whole length, a new era was opened. The speed of working was immediately increased sixfold, and the traffic capacity threefold. The enormous importance of this long stride can be judged from the fact that an Atlantic cable costs the better part of a million sterling, and that the new invention in effect reduced this part of the capital outlay by over 60 per cent.

Naturally, at the sending and receiving stations new methods had to be evolved to cope with this high-speed traffic, which has been in operation for about five years; and we have pleasure in giving in the following pages a full account of the equipment installed and the procedure followed at an up-to-date cable station—that of the Western Union Company, at Penzance—explained with the expert assistance of Commander Rollo Appleyard, whose name is familiar to submarine cable men throughout the world. This is, we believe, the only detailed description of a modern cable station that has ever been published.

What Offers for the E.T.B.I.?

A COMMUNICATION has reached us from the Secretary of the Electrical Trades Benevolent Institution concerning a matter that may have considerable bearing upon the future of that organisation if prompt action is possible. We are asked to give publicity to certain opinions that have been recently expressed by the members of the Executive Committee. The annual meeting of the Institution, at which the Council for the year is to be elected, is to be held on May 21st, and with the desire to make the governing body as representative as possible of the whole industry, the committee invites nominations for the seats on the Council which will become vacant this year. As everybody knows, the operations and interests of the Institution have grown rapidly during the last few years, and though right from the beginning there has always been an enormous amount of work to be done, the official staff and the committee-men of to-day who take their positions seriously have a task of such proportions that the uninitiated in benevolent association affairs cannot possibly grasp what it means. The invitation to send in nominations of suitable men able to introduce new ideas and willing to devote part of their time and energy to furthering the interests of the Institution should be seriously considered by all. Let it not be imagined that the present members begrudge their valuable time and service, but they make no pretence to monopoly and wish to open the door as widely as possible to others who may covet office and are qualified to hold it. It is requested that names should be forwarded to the Secretary, E.T.B.I., at 9, Southampton Street, London, W.C.1, by the end of April. As next Monday is the last day of that month, it will be obvious that the time is very short, and we think that as the meeting does not take place until May 21st, it will be possible to include names on the agenda if they are sent in early in May. Unless that be so, we are afraid that this reference to the subject is of little use.

Transformers, Cookers, and other Matters.

WHEN the information vouchsafed to the public regarding the experiences of manufacturers acting in organised association is so meagre as in the case of the last annual report and meeting of the B.E.A.M.A., one must needs have greater recourse to the matter that emanates from individual companies or firms and their representatives. The situation, as a matter of fact, becomes very similar from some points of view, to the state of affairs that existed in pre-organisation days, for it occasions gossip, rumour, and statements bearing the semblance of authority, sometimes true, but sometimes—perhaps more frequently—untrue. When organised manufacturers are really united on some specific policy or matter of which they have no reason to be ashamed, they have little hesitation in utilising opportunities for giving that subject full publicity. The same thing happens when they have prepared elaborate propaganda volumes which as they become known give the public better acquaintance with their objects and knowledge of their achievements, thus removing misconceptions which are the certain offspring of ignorance. We have a sufficiently lengthy experience of the electrical industry to know that innumerable problems arise which can only be profitably handled if they are dealt with in co-operative privacy, but individual interests in industry and trade cannot always be sacrificed for the common good, however desirable it may be to place reasonable bounds to competition.

Speeches to shareholders are not always noted for the value of the information imported, but that delivered by Mr. A. F. Berry to shareholders of the British Electric Transformer Co., Ltd., contained some points of special interest concerning the particular sections of the industry in which that company is engaged. The volume of business last year was "not too bad," but the profit margin was "meagre," and this year, so far, considerable orders have been booked, but "at very poor prices." Owing to the state of some industries consequent upon the coal strike of 1926, work of one kind and another was held up, and customers who had been pressing for delivery could not take the goods when they were ready, so that there was great congestion and expense in storing and caring for them in the works, while payment money was, of course, withheld. The most ambitious efforts at efficient production are more or less handicapped under such conditions. In addition to the foregoing, Mr. Berry referred to the holding up of big schemes involving the use of transformers, a situation which was foreseen, but which has been altered lately as the Electricity Board has got into its stride. Unfortunately, the severe handicap was strenuous competition: "In the transformer business . . . competition has been pushed to a limit beyond that which is either fair or reasonable." This, of course, is the danger if there is non-co-operation. "The desire to break any form of co-operation which might reduce costs and permit the payment of a fair wage has unfortunately been strongly marked with some of our big buyers." Mr. Berry stressed the importance of those who had influence with the railway companies doing what they could to impress upon them the fact that to keep work in this country was to enable manufacturers to reduce standing charges and costs, to pay increased wages and dividends, and so increase the spending power of the public. Everybody ought to have seen the need for helping home industries, but some buyers are too often influenced by economies that may be more apparent than real. Among the other points mentioned by Mr. Berry was the interest that has lately been taken in British electrical manufacturing industry by the large American financial houses. It is two years ago since we first discussed here the possible effects of the large loans from America to German electrical concerns, but in recent days American interest has been transferred more particularly to this country, and all sorts of developments have been proceeding, most of which we have recorded in some part or other of this journal. Mr. Berry suggests that this subject might be discussed further, and that interest in and control of movements of this kind should be taken by the British people generally, and particularly by bodies of electro-industrial shareholders. Perhaps before long the uncertainty or unsettlement that this influence is reported to have occasioned may be removed. Mr. Berry's own views would be welcome.

The lag in electric cooker business that was experienced by this company early last year when electricity consumers turned back to cheaper coal because their electric cooking and heating supply bills were so heavy, may have been due to other causes as well, and these might well be the subject of inquiry. This department is now reviving again as electricity charges have fallen, but it seems to us to require a special boosting effort. We congratulate Mr. Berry on the completion of thirty years' work for the company since he gave it birth. Probably he will recall his revision in our editorial offices of the proofs of his epoch-marking paper read before the Student Members of the Institution of Electrical Engineers on May 8th, 1896: "The Single-phase Alternate Current Transformer in Practice" (ELEC. REV., June 19th, 1896, and following issues).

Modern Atlantic Cable Operation.

In this article the author gives the first complete account ever published of a submarine cable station fully equipped with the most modern types of amplifying and repeating apparatus, the system being that of the Western Union Telegraph Company.

By COMMANDER ROLLO APPLEYARD, R.N.V.R., M.Inst.C.E., M.I.E.E.

To maintain touch with the rapidly advancing methods of telegraphy, it is desirable from time to time to select from the array of improvements a single characteristic group. During the last few years, spectacular results in newer branches have received public attention well deserved, but somewhat to the neglect on the part of general observers, of progress in submarine telegraphy. Attention, accordingly, will here be directed chiefly to the advance consequent upon "through working," the adoption of the rotary regenerator system, and the introduction of the loaded telegraph cable. For this purpose it is convenient to consider the method of operation at one of the regenerator stations rather than at the terminal stations. The opportunity will therefore be taken to describe in outline the procedure at Penzance, relating to the Atlantic cables of the Western Union Telegraph Company. The particular submarine cables composing the transatlantic routes that pass through the Penzance station of the Western Union Company are tabulated below.

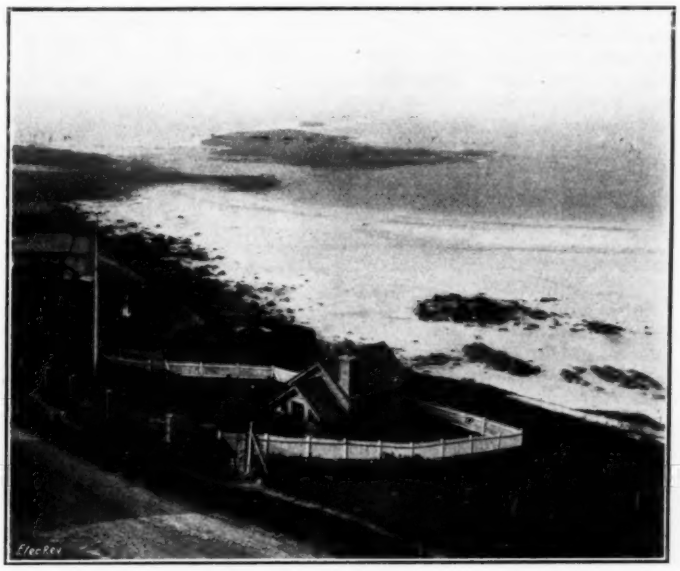


Fig. 1.—Sennen Cove, Cornwall, showing Western Union Cable Hut.

The main cables thus consist of two groups, *i.e.*, those terminating at Valentia (Ireland), and at Penzance respectively. On the American side is an extensive system of

Designation.	Route.	Length n.mls.	Predominating Core Weights. (lb. per n.m.)		
			Cu.	G.P.	Loading.
1 VA ('873) Anglo-American Telegraph Co.	Heart's Content—Valentia	1871	650	375	—
2 VA ('874) " "	" "	1874	650	375	—
3 VA (1880) " "	" "	1886	300	300	—
4 VA (1894) " "	" "	1854	650	400	—
1 VA—PZ Western Union	Valentia—Penzance	275	220	180	—
2 VA—PZ " "	" "	286	220	180	—
3 VA—PZ } (Bicore) Western Union	" "	289	130	130	—
4 VA—PZ }					
1 PZ (1881) American Telegraph and Cable Co. ...	Bay Roberts—Penzance	2131	650	375	—
2 PZ (1882) " " " ...	" "	2133	650	375	—
4 PZ (1926) Western Union ... ... " ...	" "	2023	510	340	60·9

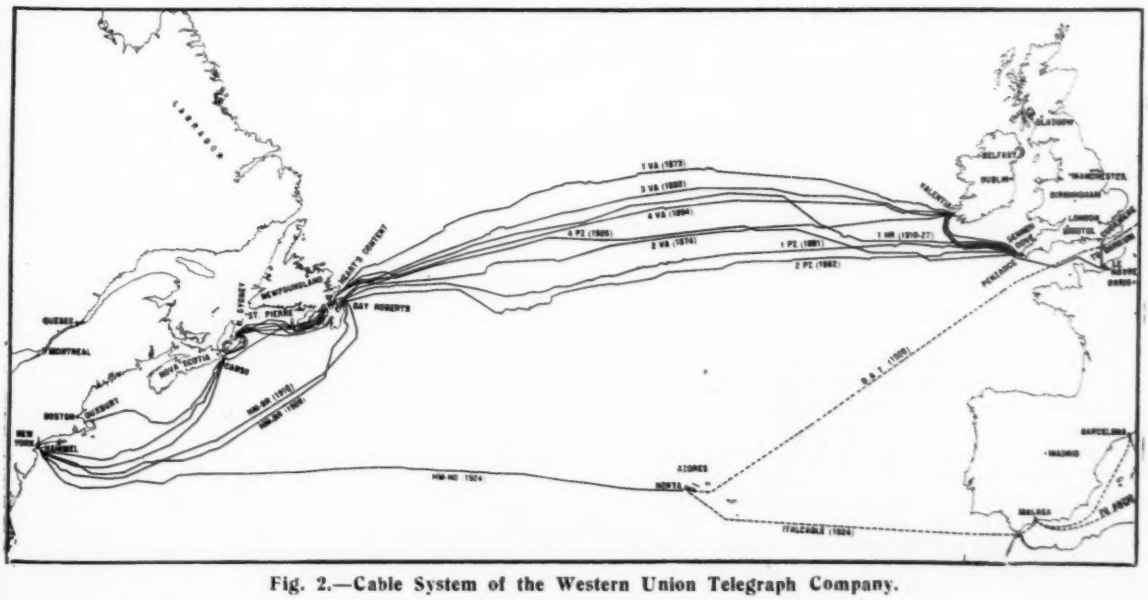


Fig. 2.—Cable System of the Western Union Telegraph Company.

connecting cables. The relay station at Penzance is connected to the terminal stations on the English side by underground land lines, rented from the General Post Office. From Bay Roberts (Newfoundland) there were until recently three unloaded cables terminating at Penzance, and to meet the increasing traffic to France it was desired to lay a connecting cable from Penzance to Havre. Unfortunately, so far as the landing rights in Great Britain were concerned, it was impossible to obtain the necessary concession; the 3PZ (1910) cable, which up to that time had connected Bay Roberts and Penzance, was consequently diverted from Penzance to Havre, and it is now known as the 1HR cable.

In 1924 a loaded cable was laid between New York and Horta (Azores). By arrangement with Italy and Germany, who laid cables to the Azores, this serves both those countries. Also, one of its multiplex channels is leased to the Commercial Cable Company. This was the first loaded telegraph cable—it was loaded with Permalloy. So pronounced was its success that, two years later, the Western Union Company provided themselves with 4PZ, and with its connecting link from Bay Roberts to New York, also Permalloy loaded, thus ensuring a loaded circuit from New York to Penzance.

The introduction of the loaded cable (4PZ), with its enormous potentialities in respect of speed, carried with it the necessity for providing equipment of an entirely new character to handle the increased traffic. The apparatus at present installed at Penzance comprises: (1) equipment for the unloaded cables, consisting of Heurtley magnifiers, Brown drum relays, and regenerators, and (2) equipment for the loaded cable, consisting of valve amplifiers and multiplex regenerators, at present providing four channels.

Every cable on the company's Atlantic system is now a link in one of nine through routes. In effect this implies that the whole of the manual work of all the cables is done at terminal stations, such as London or Liverpool, New York or Boston, and that the whole of the intermediate relaying is automatic. Definite cables and landlines are not only allotted to, but are in physical association with each main section of cable. Consequently there is no possibility of accumulation of traffic anywhere, except at terminals. The scheme, in fact, annihilates intermediate delays.

The "through traffic" scheme began, before the days of regenerators, on August 15th, 1916, when the Western Union Company joined up their 3PZ cable for through working from New York to London. For this purpose they utilised one Brown relay at Bay Roberts and another at Penzance. The company's experience with multiplex working, and the success of the landline rotary repeater introduced in February, 1920, however, led their engineers to concentrate upon the development of a synchronous regenerator for ocean cables, and they succeeded in carrying regular traffic on one cable (the 2VA) with a regenerator of experimental pattern, as long ago as December, 1921. The first cable rotary regenerator installed by the Western Union Company for permanent service was connected up with their 3PZ cable very shortly afterwards—on January 23rd, 1922—for through working between New York and London. With the Brown relay, the speed had been 170 cable-Morse letters a minute; the addition of the rotary regenerator immediately increased this speed to 250 letters a minute. This success led to the conversion to regenerator working for regular service

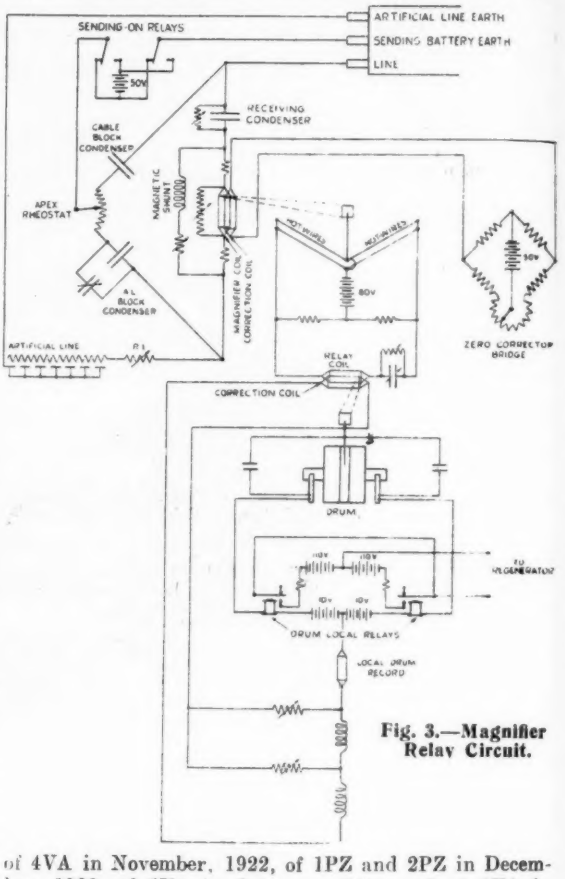


Fig. 3.—Magnifier Relay Circuit.

of 4VA in November, 1922, of 1PZ and 2PZ in December, 1922, of 1VA in January, 1923, and of 3VA in June, 1923.

The operations performed upon the currents received at Penzance from the unloaded cables are: (1) amplification, by means of a Heurtley magnifier; (2) squaring and relaying signals, by means of a Brown drum relay; (3) restoration of shortened signals from the relay to signals all of correct length, resembling the original signals at the terminal station, by means of the regenerator circuit. Operations (1) and (2) may be understood by referring to fig. 3, in which are shown the main connections composing the well-known cable duplex circuit, the magnifier and the drum relay, together with the chief adjuncts to these instruments.

The magnifier (fig. 6, p. 719) comprises two pairs of current-heated wires which form a Wheatstone bridge system. One pair of wires is attached to a suspended

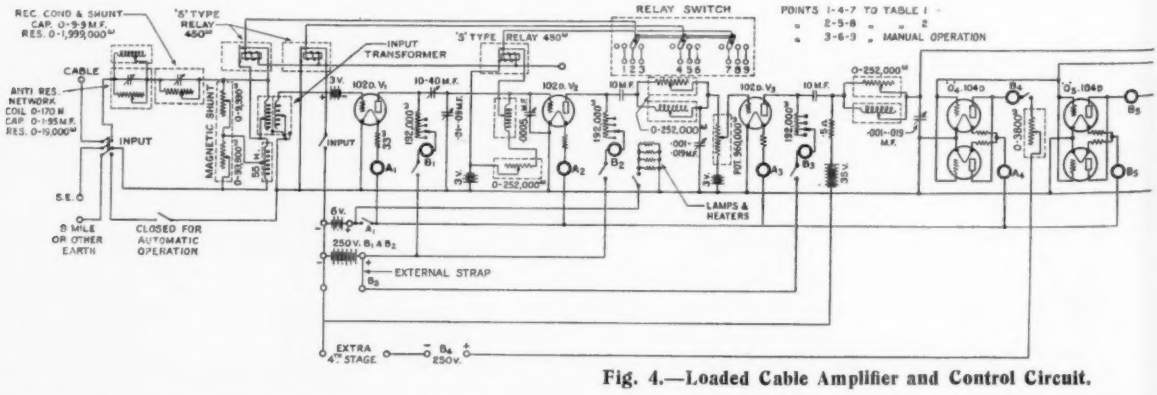


Fig. 4.—Loaded Cable Amplifier and Control Circuit.

pointer, which is connected by quartz fibres to the main receiving coil operated by the line currents. The other pair of wires is stationary and lies directly beneath, but the wires are so arranged that one lies slightly behind and the other slightly in front of the movable pair. The wires used are of pure platinum about 0.25 mil in diameter, and the current used to heat them is approximately 120 mA supplied by a 50-volt battery.

The instrument depends for its action upon the variation in proximity of the current-heated wires to each other, causing changes in their resistance. These changes result in currents passing through the drum relay main coil, which is placed in the null circuit of the Wheatstone bridge system. A second coil, termed the "correction coil," is wound on the same former as the main coil, and is used in conjunction with a local battery and a manually-operated rheostat to correct any abnormal wandering of the pointer caused by extraneous currents from the cable.

The drum relay (fig. 7, p. 719) consists of a moving coil system, the winding of which is divided into two sections (main and correction coils) of approximately 500 ohms and 200 ohms resistance respectively. By means of two quartz fibres the coils are mechanically connected to a vertical front suspension in a manner similar to that of the magnifier. The front suspension carries a tongue or contact member, consisting of a fine glass tube through which passes a thin phosphor bronze wire with an iridium tip. The tip bears lightly upon and makes contact with the silver surface of a revolving drum driven by a small motor. The drum is constructed of three silver rings, the central one being insulated from the others by two thin mica discs. The outer rings are connected with the local battery through the coils of the drum local relays. A current through the main coil causes the pointer to move from the central insulated ring (known as the "no-man's land") to one or other of the outer rings. This movement completes a circuit through the dot or dash "drum local relay," and operates its tongue, which in turn sends a current to the pick-up segments of the regenerator.

The correction coil, with its associated inductances and resistances, plays a very important part in the relaying of signals, and forms what is known as the local correction circuit. The object of this circuit is to regulate the flow and time rate of increase of the current through the correction coil so that it will counteract the falling-off of the current in the main coil due to the charging-up of the cable and condensers,

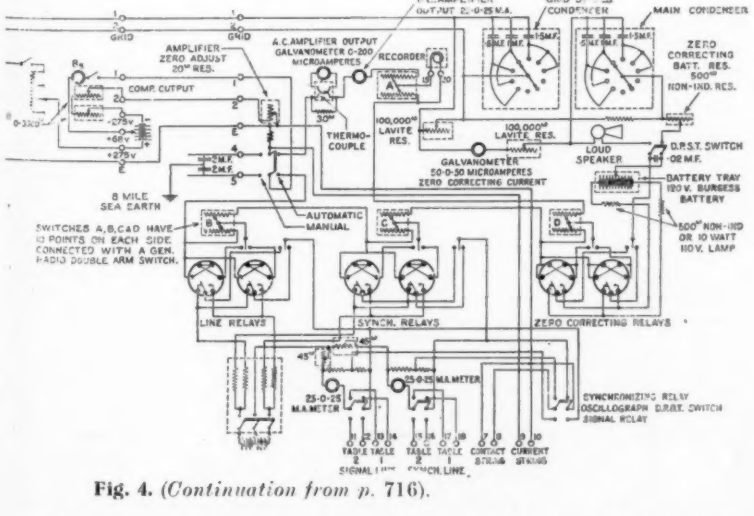


Fig. 4. *(Continuation from p. 716).*

and will thus hold the pointer in position throughout a succession of signal elements of one polarity.

As in the case of the multiplex, from which it was derived, the regenerator, or rotary repeater, depends for its effective working upon synchronism between all stations—whether terminals or intermediates. Synchronism in the Western Union system is maintained by the signals themselves. The function of the regenerator is to take a signal element from a Brown drum or other cable relay and to convert it into a new element for transmission into the next section of the route. It is to be observed that the regenerator is not only for what is variously termed "magnifying," "amplifying," or "strengthening," but it is concerned with *shaping* the signals, giving them correct length and relative phase.

The regenerator employed by the Western Union for the purpose of relaying cable recorder signals is known as their Rotary Repeater 3-B. It selects a portion from the middle of each signalling impulse and re-transmits it in the form in which it left the distant transmitter. Only 20 per cent. of the incoming signal is required for this purpose, and it can be re-transmitted with any degree of "marking" from 60 to 100 per cent. as required.

Essentially the Rotary Repeater 3-B consists, fig. 5, of a circular distributor face plate, over the surface of which four pairs of brushes mounted on a common holder are rotated by a phonic (or La Cour) motor, which is driven by the impulses received from a driving fork of specially robust design. Provided that all the brush holders at stations along the cable route rotate in synchronism, the regenerating functions will be carried out, and no "clipping" or distortion will be passed from one station to the next. The method of maintaining synchronism is described later. At the opposite end of the motor shaft to that of the brush holder is mounted a hollow flywheel filled with mercury still further to assist steady, smooth running.

The face plate consists of eight concentric rings (shown developed in the figure), of which the outer four (Nos. 1-4) are segmented and the inner four (Nos. 5-8) are solid. The four pairs of brushes on the brush holder are fixed in the form of a cross and are arranged so that they constitute the rotating electrical connections between rings 1 and 5, 2 and 6, 3 and 7, and 4 and 8 respectively. No. 1 ring, which is known as the "receiving" ring, consists of 40 segments, and as 10 segments are allotted for each signalling impulse, four separate signal elements are regenerated during each complete revolution of the brushes. The first two segments of each quadrant (fig. 5) are strapped together to form the main receiving or "pick-up" segments, and the remaining eight are strapped together to form the "locking" segments. The operation can be traced as follows:—

Let it be supposed that a dot is transmitted from the distant station and that, after being amplified by means of the Heurtley magnifier, it actuates the Brown drum relay, which in turn causes the armature of the dot drum local relay (A) to be attracted. A circuit is then established from the positive side of the local 110-V battery, the contact of the dot local relay, pick-up milliammeter, pick-up segments (ring No. 1), *via* the brushes to ring No. 5, lock-up milliammeter, coils of the polarised locking relays, coils of the polarised sending-on relays to the centre of the battery. The relays used in the pick-up, locking and sending-on positions are of a type standardised throughout the company's system; they are manufactured to Western Union specifications, and the type is known as Combination Wheatstone Relay 1-D. Its main constructional details resemble those of the Post Office type "G." In the case under review, to provide a bias to the relay tongues against their spacing stops, a permanent current is passed through the auxiliary windings of each relay. The strength of this biassing current can be varied as required by means of a separate rheostat and milliammeter. It will be noted that the main windings of each

pair of relays are so connected that the current flows in opposite directions through each separate relay; thus, when the dot (positive) current flows, the dot relay tongue is moved to its marking stop, and the dash relay tongue is more firmly held to its spacing stop, the whole operation, of course, being reversed when the dash (negative) current is applied.

The dot current, passing through the coils of the locking relays, causes the armature of the dot relay to move over to its marking stop, which immediately applies the same potential to the remaining eight segments of the quadrant and thus allows the duration of the initial signal to be prolonged proportionately. For the reason that the coils of the sending-on relays are in series with the coils of the locking relays, it will be seen that the sending-on relays will transmit into the next section of line the combined signal set up by the current passed by both the pick-up and locking segments. Switches are provided so that one or more of the locking segments may be disconnected and so that the percentage marking is thereby varied as required.

Synchronism is maintained in the following manner: The driving fork of the receiving distributor is adjusted so that the motor runs slightly faster than the sending distributor at the distant end. To determine the correct speed at which the receiving distributor is to be set, the pulse from the corrector relay can be diverted by means of a switch to a bank of five lamps — connected, on one side, to the segments of ring No. 4, and on the other to the return side of the battery. The direction in which the sequence of flashes moves, and the number of flashes on each lamp, indicate how the driving fork should be adjusted so that the correct speed may be obtained.

The shaft carrying the distributor brush holder is coupled through a reduction gear to the corrector mechanism, which in turn is clamped to the motor shaft carrying the armature and flywheel. Electrical connection to the corrector is made by a pair of brushes and collector rings. When the corrector operates, the driving pinion, which is normally prevented from rotating by means of a jockey roller, and therefore runs solid with the driven wheel, is rotated one tooth. This operation has the effect of stepping back the brushes to the extent of 1½ degrees of arc.

When the brushes are in contact with the pick-up segments of the receiving ring, there are two paths for the current from the tongue of the drum local relay—one through the coils of the locking and sending-on relays as already described, and the other through the coils of the corrector relay, the armature of which will move over to its marking stop each time a dot (positive) is received, and will thereby complete a circuit from the 110-V local battery through the "break" relay in the synchronising unit. During the travel of the "break" relay armature, and before its contacts are opened, the current divides, and one part completes a circuit through the contacts to ring No. 6. Now, if the brushes are in such a position that they connect the solid ring (No. 6) with one of the "live" segments on the segmented ring (No. 2), two parallel circuits are made: one through the coil of the "make" relay to negative—thus closing its contacts—and the other through a resistance and the coil of the "shunt" relay to negative; owing to the high impedance of this circuit, however, the "shunt" relay armature is not operated at this stage. The closing of the "make" relay contacts establishes three circuits from the positive 110-V battery:—

(*a*) Through a resistance and its own coil, thus locking the contacts.

(*b*) Through the corrector magnet, thus stepping back the brushes as previously described.

(*c*) Through the coil of the slow-acting "shunt" relay, the contacts of which are thereby closed and act as a short circuit across the coil of the "make" relay, thus completing the full cycle of operations by restoring both relays and the corrector magnet to normal.

Unless the brushes are in contact with a "live" segment, no correction can take place; hence, assuming that the correct speed relationship between the sending and receiving distributors has been established at the start, synchronism will be maintained purely by the effect of the change of sign of the line currents.

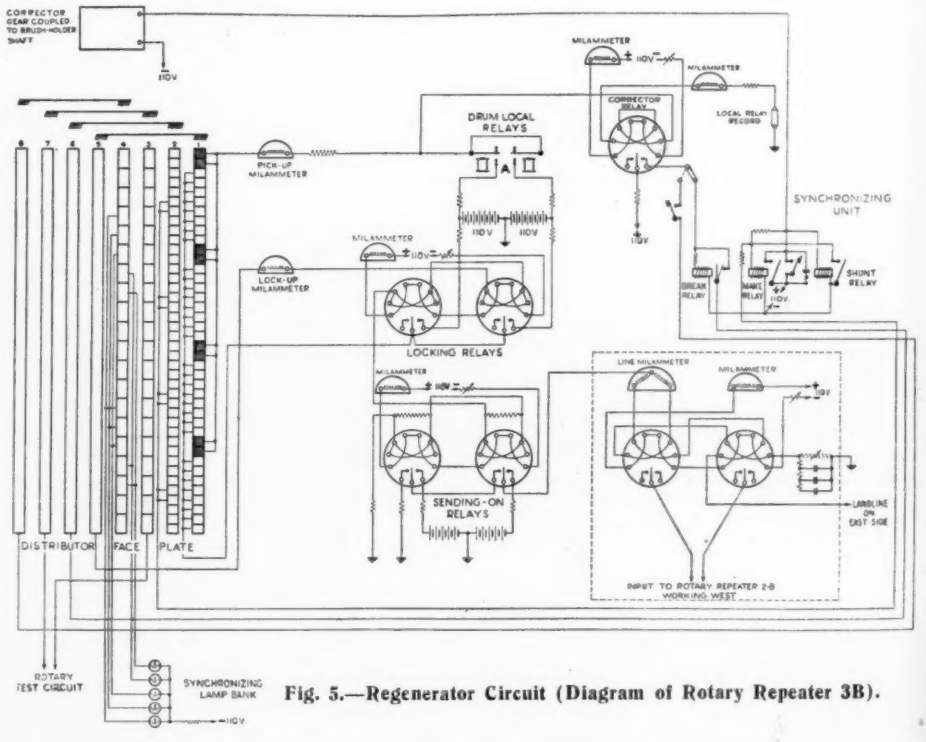


Fig. 5.—Regenerator Circuit (Diagram of Rotary Repeater 3B).

Owing to the difference in resistance, the greater part of the current from the drum local relay flows through the coils of the locking and sending-on relays, and while this is taking place the current through the corrector relay is reduced proportionately. The effect is shown by a "flick" in the incoming signal as recorded on the direct writer, which, it will be seen (fig. 5), is inserted in series with the coils of the corrector relay. The "flick" therefore enables the relationship of the pick-up segments to the incoming signal (or the point where the brushes are in contact with the pick-up segments) to be determined.

Naturally it is desirable to arrange for the "flick" to occur as near as possible to the centre of the signal, and this is done by orientating the receiving ring (No. 1) with respect to the correcting ring (No. 2). Fig. 19 shows the incoming signal from line (at top); the drum local relay record (in centre), and the outgoing signal from the tongues of the sending-on relays (at bottom), and illustrates the pick-up occurring at different parts

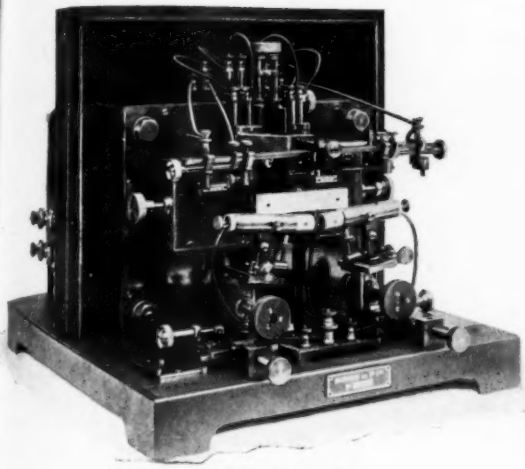


Fig. 6.—Heurtley Magnifier.

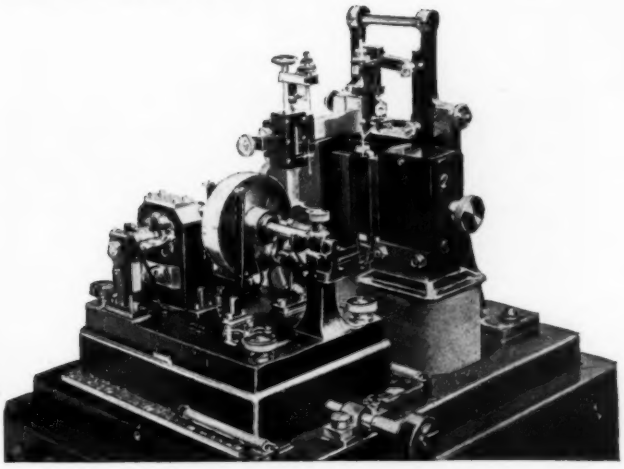


Fig. 7.—Brown Drum Relay.

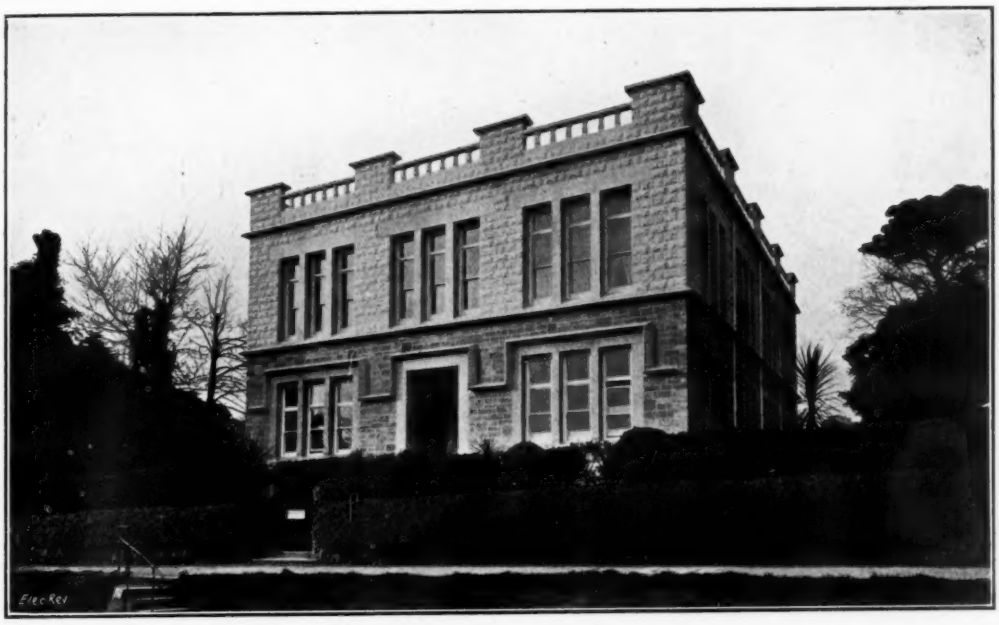


Fig. 8.—Western Union Cable Station, Penzance.

Fig. 9.—General View of Operating Room.

Fig. 10.—Operating Room, showing Main Jack Panel, and a Group of Regenerator Tables.

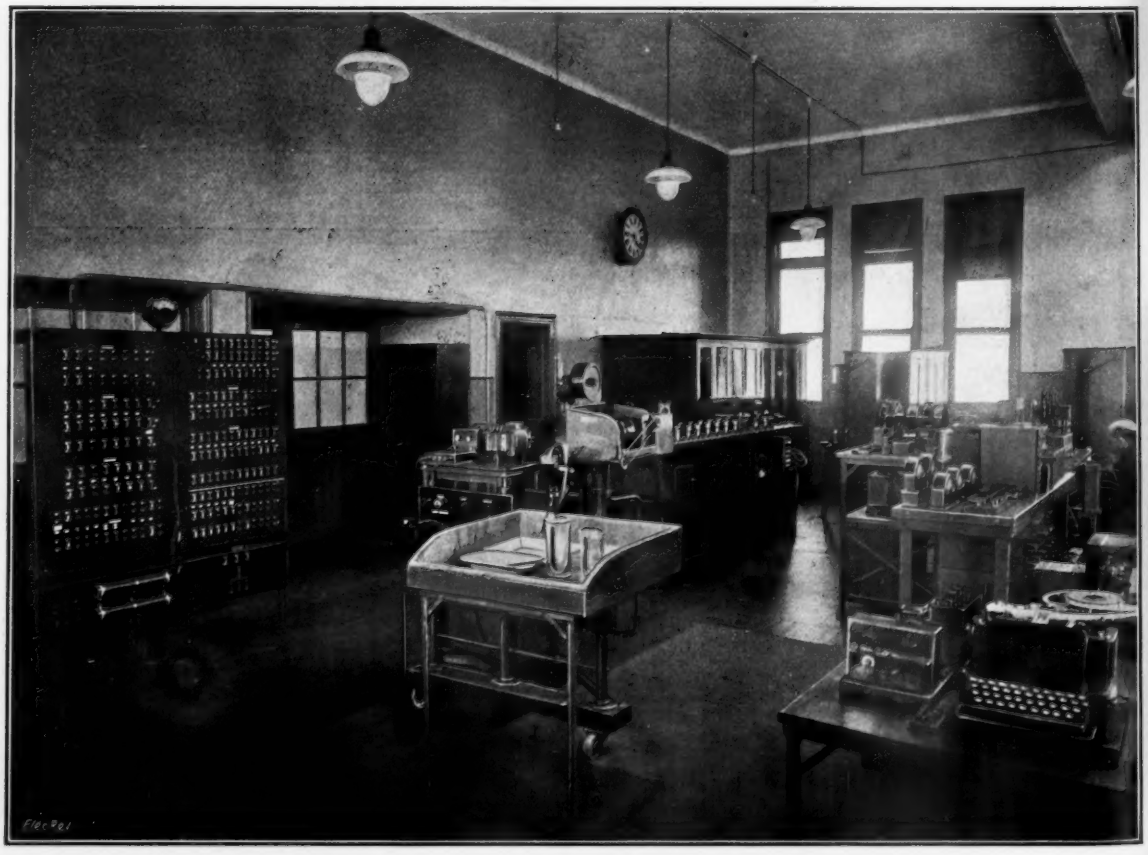


Fig. 11.—Operating Room, showing Main Fuse Panel and Loaded Cable Equipment.

Fig. 12.—Exterior of Sennen Cable Hut.

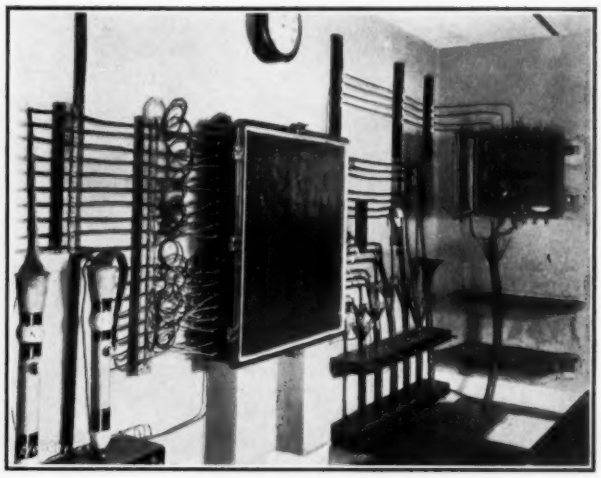


Fig. 13.—Interior of Cable Hut.

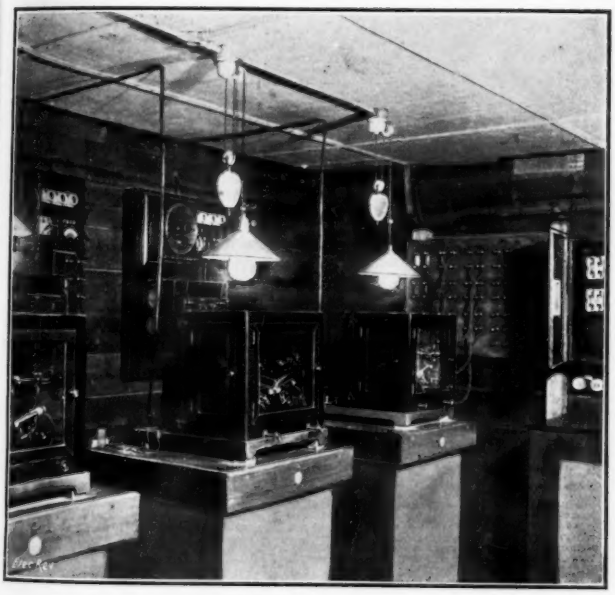


Fig. 14.—Heurtley Magnifier Room.

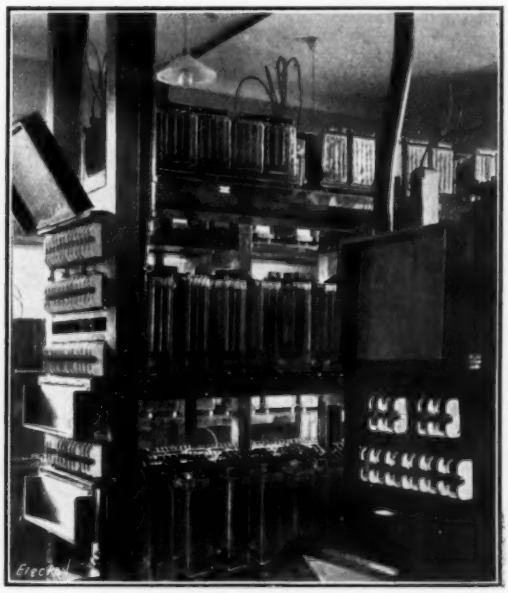


Fig. 15.—Battery Room.

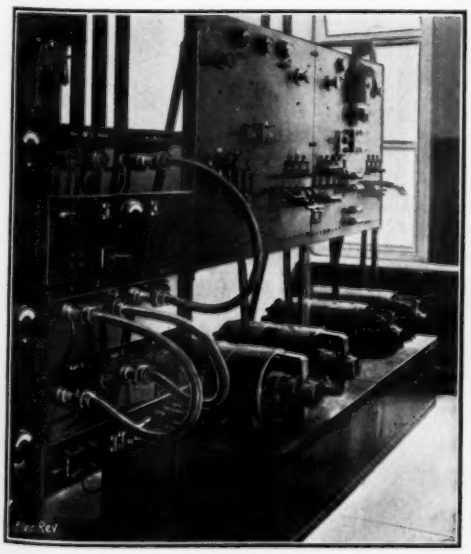


Fig. 16.—Valve Amplifier Battery Charging Plant.

Fig. 17.—Main Power Plant.

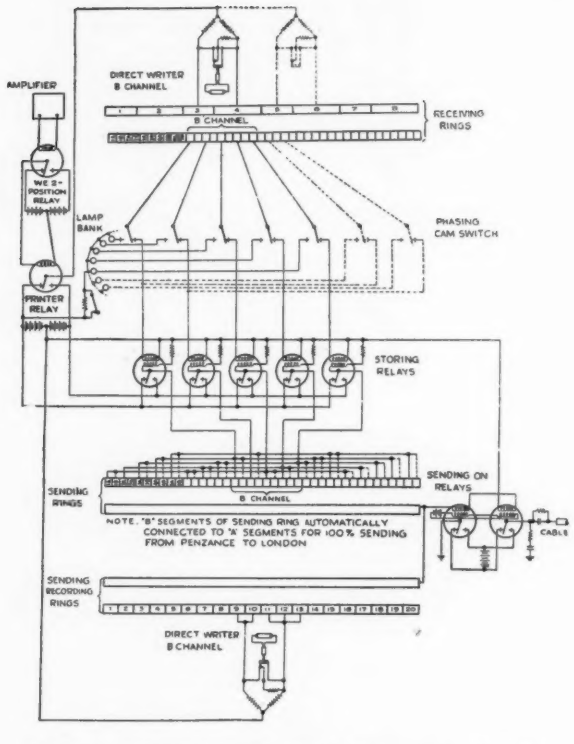
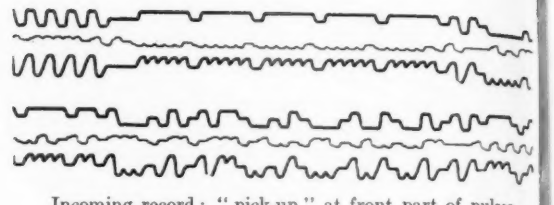
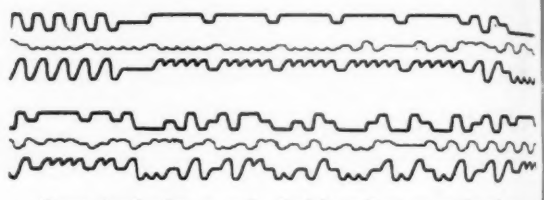


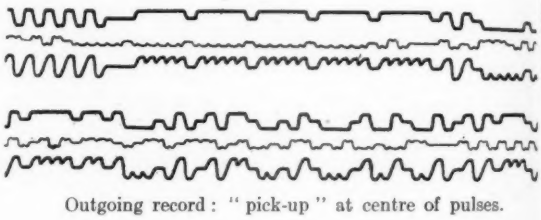
Fig. 18.—Loaded Cable Multiplex Regenerator Circuit.



Incoming record: "pick-up" at front part of pulses.



Drum local relay record: "pick-up" at rear of pulses.



Outgoing record: "pick-up" at centre of pulses.

Fig. 19.—Specimen of Record used at Regenerator Stations.

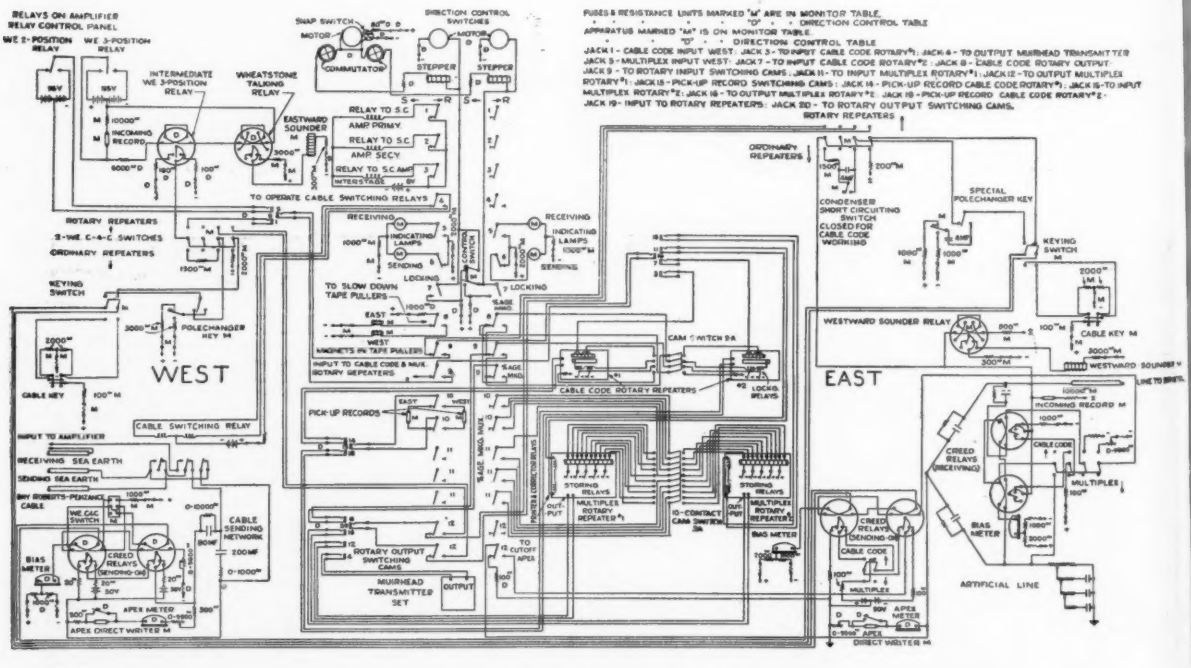

RELAYS ON AMPLIFIER RELAY CONTROL PANEL
WE 2-POSITION RELAY
WE 3-POSITION RELAY
INTERMEDIATE WE 3-POSITION RELAY
WHEATSTONE TALKING RELAY
SNAP SWITCH
MOTOR
COMMUTATOR
DIRECTION CONTROL SWITCHES
STEPPER
EASTWARD SOUNDER
INCOMING RECORD
RELAY TO S.C. AMP PRIMY.
RELAY TO S.C. AMP SECY.
RELAY TO S.C. AMP INTERSTAGE
TO OPERATE CABLE SWITCHING RELAYS
ROTARY REPEATERS
2-WE C-4-C SWITCHES
ORDINARY REPEATERS
KEYING SWITCH
POLECHANGER KEY
WEST
CABLE KEY
CABLE SWITCHING RELAY
INPUT TO AMPLIFIER
RECEIVING SEA EARTH
SENDING SEA EARTH
BIAS METER
CREED RELAYS SENDING-ON
APEX METER
APEX DIRECT WRITER M
CABLE SENDING NETWORK
RECEIVING
INDICATING LAMPS
SENDING
LOCKING
TO SLOW DOWN TAPE PULLERS
EAST
WEST
MAGNETS IN TAPE PULLERS
INPUT TO CABLE CODE & MUX. ROTARY REPEATERS
PICK-UP RECORDS
ROTARY OUTPUT SWITCHING CAMS
MURHEAD TRANSMITTER SET
OUTPUT
TO CUTOFF APEX
FUSES & RESISTANCE UNITS MARKED "M" ARE IN MONITOR TABLE.
APPARATUS MARKED "M" IS ON MONITOR TABLE.
DIRECTION CONTROL TABLE
JACK 1 - CABLE CODE INPUT WEST. JACK 3 - TO INPUT CABLE CODE ROTARY*1; JACK 4 - TO OUTPUT MURHEAD TRANSMITTER
JACK 5 - MULTIPLEX INPUT WEST. JACK 7 - TO INPUT CABLE CODE ROTARY*2; JACK 8 - CABLE CODE ROTARY OUTPUT.
JACK 9 - TO ROTARY INPUT SWITCHING CAMS. JACK 11 - TO INPUT MULTIPLEX ROTARY*1; JACK 12 - TO OUTPUT MULTIPLEX ROTARY*1; JACK 13 - PICK-UP RECORD SWITCHING CAMS; JACK 14 - PICK-UP RECORD CABLE CODE ROTARY*1; JACK 15 - TO INPUT MULTIPLEX ROTARY*2; JACK 16 - TO OUTPUT MULTIPLEX ROTARY*2; JACK 18 - PICK-UP RECORD CABLE CODE ROTARY*2.
JACK 19 - INPUT TO ROTARY REPEATERS. JACK 20 - TO ROTARY OUTPUT SWITCHING CAMS.
ROTARY REPEATERS
ORDINARY REPEATERS
CONDENSER SHORT CIRCUITING SWITCH CLOSED FOR CABLE CODE WORKING
SPECIAL POLECHANGER KEY
KEYING SWITCH
WESTWARD SOUNDER RELAY
CABLE KEY
WESTWARD SOUNDER
EAST
INCOMING RECORD
CREED RELAYS (RECEIVING)
CABLE CODE
MULTIPLEX
BIAS METER
ARTIFICIAL LINE
CAM SWITCH 8A
CABLE CODE ROTARY REPEATERS
LOCKING RELAYS
STORING RELAYS
MULTIPLEX ROTARY REPEATERS
10-CONTACT CAM SWITCH 20A
CREED RELAYS SENDING-ON
CABLE CODE
MULTIPLEX
APEX METER
APEX DIRECT WRITER M

Fig. 20.—Loaded Cable Direction-Control Connections.

of the signal element. From these examples it is seen that, although originally transmitted as beats, the incoming signals (top record) are blocked, owing to the speed of transmission and the attenuation of the cable. As the bottom record shows, the regenerated signal is in this case retransmitted in its original "beat" form. In the case of the Rotary Repeater 3-B, the conversion is effected by disconnecting one or more of the locking segments as previously explained, but when a cable is to be relayed into a land line, and *vice versa*, it is necessary to change the degree of marking as compared with the original signal. Under land-line conditions, block signals, by virtue of the more permanent nature of the line current, are less liable to distortion from parasitic currents, and a block signal of the order of 100 per cent. marking is sent into the land line from the regenerator. In the other direction—for example, when incoming signals from London are being relayed into the cable—the Brown drum relay is replaced by a pair of Combination Wheatstone Relays, 1-D, working into a Rotary Repeater 2-B. The 2-B differs from the 3-B in that the pick-up current returns direct to the battery after leaving the coils of the locking relays, and consequently the sending-on relays only transmit the signal set up by the locking segments, which is in effect a "beat" signal of 80 per cent. maximum marking.

By the regenerator system, it is possible to send and to receive telegraphic signals all round the world. Theoretically, the risk of dropping an element of a letter increases as the number of regenerating stations in the circuit increases, but practically this risk is negligible. Signals were in 1925 received by this system in London from San Francisco *via* Hearts Content—a distance of about 6,000 miles—through five regenerating points and sixteen land-line repeater stations.

Now, as formerly, efficient reception on unloaded cables depends upon the maintenance of the duplex balance. On loaded cables, duplex working has not yet been realised. The speed of signalling attained simplex over a loaded cable of the 4PZ type, however, is much in excess of anything that could be accomplished by duplex working on an unloaded cable.

So far as the balancing of unloaded cables is concerned, the care that has been bestowed upon the problem has been rewarded by electrical stability that is now entirely satisfactory. During an average month, the cable time lost at Penzance in consequence of having to adjust duplex balance is not more than one minute per cable per day. This degree of efficiency has been secured: (1) by the use of artificial lines having as nearly as possible zero temperature coefficient; (2) by the maintenance of a high degree of dryness in the artificial line room and in the duplex adjustment cabinets; and (3) by the use of four wires per cable in the underground cables between Penzance and the cable-hut at Sennen Cove.

For the circuit from the loaded cable, the Heurtley magnifier and Brown drum relay are replaced by an amplifier of the four-stage valve type operating through shaping networks, to which is added a special zero correcting device controlled by valves (fig. 4). This equipment was specially developed by the Bell Telephone Laboratories. Starting from the cable, the circuit comprises first an anti-resonant network, which is a simplified form of band-pass filter, to reduce the amplitude of certain of the lower frequencies. This is rendered necessary by the circumstance that the cable has a band of frequencies that predominates abnormally. That band is required in the ordinary course of events, but if it is allowed to assert itself unduly, subsequent shaping operations are rendered difficult.

From this network the signal passes to a shunted receiving condenser and into an auto-transformer that serves the purpose of a magnetic shunt for curbing the received impulses. The auto-transformer itself forms a shunt to the main input transformer. By one path the signal then traverses about 112 nautical miles of balancing core within the same sheathing wires as the main core of the cable, and then through a resistance of about 460 ohms of manganin wire to earth on the sheathing of the cable. The signal passes to the first valve from the secondary of the input transformer. By this time the major portion of the shaping has been accomplished, but the shape requires improvement and the whole requires amplification. Amplification is effected by the resistance-capacity method. Additional condensers and inductances are used between stages for shaping and for leaking to earth extraneous interference currents through three stages of voltage amplification. Finally, there is a power or output stage, the total amplification being 20,000 : 1. The incoming signal has a potential of only a few millivolts.

The voltages used are, on the first three stages, the "B" or anode battery of 250 volts, and the "C" or grid-bias batteries of 0-18 volts; the last stage has a separate "B" battery of 276 volts and a grid-bias battery of about 45 volts. A common 6-volt filament battery is used. The output from the amplifier passes to special relays. As the permanent spacing current from the last valve is balanced out, only the signal variations operate these relays—which are in the null circuit. A thermo-couple with a scaled current meter is in circuit with the coils of the relays to indicate the output current.

In the absence of duplex arrangements on the loaded cable, special means have been developed for quickly transferring from east to west or from west to east, both for sending and receiving. This is accomplished by an automatic switching gear known as a direction-control unit (fig. 20, p. 722). Apart from phasing, this performs about 30 operations in six seconds, with the utmost efficiency. Cams make the changes in correct sequence, including changing the connections in the sea-earths, amplifier, relay control contacts, batteries, local relays, local records, and tape-pullers, and at the same time they give a warning to the battery attendant and to operators at various points. The control switches can, if necessary, be set to operate automatically at all stations at predetermined intervals of time. In addition to the switching circuit, the diagram (fig. 20) shows the relationship between the regenerators and the remainder of the circuit, including the alternative connections for 5-unit or recorder working.

The regenerator (fig. 18) employed for the purpose of relaying the 5-unit code signals on the loaded cable (4PZ) differs in many respects from the Rotary Repeater 3-B already described. In this case the incoming signals operate the receiving relay, the tongue of which distributes the incoming pulses to a group of five storing relays which lock-up the pulses for retransmission into the next section of cable. Each locking relay is assigned to receive, to lock up, and to retransmit the impulse for a given element of the letters on all four channels. Thus the first, second, third, fourth, and fifth storing relays are used respectively for dealing in this way with the impulses for the first, second, third, fourth, and fifth elements of the letters. These relays are operated through the receiving rings of the face plate.

The segmented receiving ring consists of forty equal segments, electrically divided into four groups of ten segments each, each representing one channel. The alternate segments of each group are designated "A" and "B" respectively. Thus, in each channel-group of ten segments, there are five "A" segments separated from each other by five "B" segments. The "A" segments, only, in each group are used, and the "B" segments are idle, so that only 50 per cent. of the length of each received impulse is selected for operating the storing relays. The first, second, third, fourth, and fifth "A" segments for each channel are connected to the left-hand side of the receiving windings of the first, second, third, fourth, and fifth storing relays respectively. The right-hand sides of the receiving windings of the five relays are connected together to the centre of the split battery.

The brushes which revolve over the face plate are so synchronised and phased that they pass over the first "A" segments in any group while the first element of

the letter on that channel to be retransmitted is being received on the receiving relay. The tongues of the storing relays are moved to their marking contacts when a negative pulse is received, and to their spacing contacts when a positive pulse is received. When there is no current in the receiving windings of the storing relays, their tongues remain held to the contacts to which they were previously moved by a current through the relay locking windings. This circuit is established from the battery on the contact on which the storing relay tongue is resting, through the tongue, through the locking windings of the relay, to the centre of the battery. The current in this circuit is sufficient to hold the relay tongue to its proper contact, but it can be easily overcome by the normal receiving impulses.

The tongues of the locking relays are connected to the "A" segments in the sending ring in exactly the same manner as the relay windings are connected to the receiving segmented ring, except that the segments to which the relay tongues are connected are located three "A" segments in advance of their corresponding receiving segments, so that the relays may settle firmly on their contacts before the impulses are transmitted. The solid sending ring is connected to the windings of the sending-on relays; the impulses are accordingly sent into the cable.

As 50 per cent. marking impulses are required for transmitting the signals into a cable section, only the "A" segments on the sending ring are used for this purpose. At Penzance, however, for eastward working, 100 per cent. signals are transmitted into the underground lines to Bristol and London. This is accomplished by connecting the "B" segments of the sending ring to their corresponding "A" segments by means of the direction control switch cams and contacts.

The receiving segments of the face plate may also be connected to a phasing lamp bank by means of two ten-contact cam switches. When the cam switch levers are pulled out, the lamps are lighted by the incoming signals, and by this means synchronism and phase are obtained.

Synchronism is maintained by a modified form of the system already described for the Rotary Repeater 3-B.

Under standard multiplex conditions, the line currents from the transmitters are reversed on alternate channels; thus the spacing currents for all five elements on the A and C channels are negative, whilst the spacing currents for B and D channels are positive. This ensures that when all transmitters are at rest, the necessary alternations in direction of line current are taking place, essential to maintenance of synchronism. Although this arrangement is satisfactory for land lines or for unloaded cables, the possibility exists, when only one channel is working, of a long train of unidirectional impulses being transmitted—a condition which would be liable to bias the amplifier if employed on 4PZ. To overcome this, the split channel system is employed, in which the common spacing and marking contact bars of each transmitter are divided, so that when the transmitter is at rest the first two segments of the quadrant transmit currents of polarity opposite to that of the remaining three, and thus the number of alternations over any given period is increased, with corresponding reduction of risk of biassing the amplifier. The receiving ring—solid in the case of the standard multiplex—is divided in a manner corresponding with the divisions of the transmitter contact bars. The first segment for each channel is of the same length as two "A" and two "B" segments, and the second segment for each channel is equal to three "A" and three "B" segments. A pair of rings is provided whereby individual channel incoming and outgoing records may be obtained. The incoming records are produced by connecting the direct writer in series with the receiving-relay tongue circuits. It will be seen from the way in which the direct writer circuit is introduced (fig. 18) that the siphon will respond to marking impulses in the same direction whatever their polarity. Although the segments are arranged for 100 per cent. marking record, the current in the circuits of the receiving segments flows for only 50 per cent. of the time, so that a 50 per cent. direct writer record is obtained.

If occasion arises, equipment is available for relaying on the loaded cable by means of a high-speed recorder regenerator known as the Rotary Repeater 4-A. In such a case, the amplifier could receive the recorder-code signals from the cable without considerable readjustment. A high-speed emergency recorder-code transmitter is also installed at Penzance; it appears on the right of fig. 11.

As the use of recorder-code—by robbing the cable of the advantages of channelling—would lower the traffic capacity, this equipment would only be used in case of emergency. The Western Union have worked some of their unloaded cables on the 5-unit printer system for about two years, and have thereby obtained an increase in speed of about 30 per cent.

Except in the case of the loaded cable, the choice between recorder and printer working is not easy to make. As offsets to the gain in letter capacity, the duplex balance requires greater refinement and—what is of more importance—at the receiving terminals, owing to the time required for the slip to project beyond the machine before being available for handling, there is a lag of about 15 seconds: the Western Union equipment permits of the use of either system at any time. In general, for this reason the company works recorder on the unloaded cables, and the delivery copy is typed direct from the siphon.

It is estimated that, by increasing the number of channels, the 4PZ loaded cable will be rendered capable of operating at nearly twice the present working speed, *i.e.*, at 2,500 letters per minute. The apparatus for this speed is being designed and will shortly be installed. This speed will correspond to a reversal frequency of over 100 cycles per second.

As an independent check upon the degree of perfection of the signals sent out from the regenerators, a camera oscillograph—to be seen at the middle of fig. 11—is occasionally used. It photographs the signals without introducing any distortion of its own. It is therefore of great service in shaping the signals, in the adjustment of the amplifier, in forming shaping networks, and in the detection of minute extraneous interferences.

With the introduction of through working and mechanical operation, errors of transmission and of reception have been greatly reduced. The limit of manual working used to be about 150 letters per minute, and efficiency represented by one error in about 2,000 words was regarded as high. With through working, the manual part of the operations is now handled by only two men—the sender and the receiver at the terminal stations. This makes for precision and for secrecy, and combined with speed and continuity it establishes submarine telegraphy, in the realm of transmission and reception, supreme.

Unless there is continuity of service, there is no advantage in multiplicity of channels. If there is continuity of service, the channel system lends itself admirably to high-speed working. The limits of accuracy are closely associated with the limits of speed. For example, when typing from running recorder slip, 300 letters per minute would be beyond the powers of a man to deal with accurately. The safe upper limit is found to be about 275 letters per minute—actual work is being done on 4VA at from 250 to 260 letters per minute. This is by "touch-typing," *i.e.*, typing without looking at the keyboard. With keyboard perforation, however, also by touch, the work is being done at 325 letters per minute—possibly because the touch is lighter and because there are easier conditions of mental absorption. This figure is in harmony with the fact that the 4PZ loaded cable, with four channels, is now working at $325 \times 4 = 1,300$ letters per minute.

Most of the 3-B regenerators installed in the Penzance office are available either for recorder or for 5-unit code operation. All main connections are brought through a central jack panel (fig. 10), which

permits the maximum flexibility for circuit crosses and testing. The equipment, in addition to being standardised at all the company's stations, both in Europe and North America, is mainly made up of instruments and material interchangeable with those used for other methods of working, such as the land-line multiplex, and consequently can be manufactured in large quantities with corresponding reduction in first cost.

Fig. 9 illustrates the operating room. It shows one of the cable relay tables, the loaded cable amplifiers, and regenerators. The table on the right, at which two "watchers" are seated, has mounted on it the drum relays and duplex adjustment apparatus for the 1PZ and 2PZ cables, together with the local relays, records, and land-line apparatus for these two circuits. The cabinets beyond this table, with small loud-speakers attached to them, contain the loaded cable valve amplifiers. Beyond these again is the main cable panel serving the whole office. On the left of the amplifiers are the watching table and the multiplex regenerators for the loaded cable. The tables on the left are identified with the connecting cables between Penzance and Valentia.

A characteristic of the operating room at Penzance is the absence of visible stray connecting wires or cable forms. All wires are taken through floor-ducts, and all local and landline circuits pass through a central distributing frame situated behind the jack panel.

The power plant at Penzance consists of motor-generators (figs. 16 and 17) for converting the town supply (415 volts, 3 phase, 25 ~) to the various direct-current voltages required, the chief of which are:

400 volts for charging amplifier anode batteries.

110 volts local current supply for forks, phonic motors, tape pullers, relay biassing, local relay operating, and for charging cable sending batteries, Heurtley magnifier hot-wire batteries, magnifier and relay corrector batteries.

14 volts for charging the 10-volt cable local batteries.

8 volts for charging 6-volt amplifier filament batteries.

Line currents are supplied by special motor generators which convert the local 110 d.c. voltage to 120 positive and 120 negative for the earthed land lines and to any voltage between 60 and 120 (positive and negative) as required for individual metallic circuit land lines.

Continuity of the local 110-V supply is ensured by maintaining a 306 ampere-hour battery floating across the bus-bars. There is also a petrol-driven generator for use in case of prolonged interruption of the town supply. Moreover, all the important rooms of the building are fitted with small low-wattage emergency lamps—as seen between the ordinary fittings in fig. 9—that come into circuit automatically if the town supply fails.

The cable hut (figs. 1 and 12) at Sennen Cove, where the cables land, eight miles from Penzance, is built of local granite, with an inner wall of brick. It has a slate roof and teak doors, windows and shutters. The interior arrangements are illustrated in fig. 13. The six unloaded cables are brought up through the floor of the hut in a group, and are clamped side by side to the wall between blocks of teak. The loaded cable is by itself to the right of this group, and the lead-covered dry-core cables communicating with the Penzance station are to the extreme left. Two cast-iron terminal boxes, fastened to the wall, contain insulating pillar terminals, and jumper wires for the connections between land lines, earths, and cables. The doors of the boxes are made air-tight, and there is provision for desiccation by calcium chloride. Attention may be directed to the manner in which, from within each of these seven cables, emerge three cores, one from the "line" conductor, one from a short core extending to a "sending" earth on the sheathing, and another from a longer core to a "receiving" earth on the sheathing. One of the lead-covered cables on the left contains eight screened pairs; the other contains a central quad and eight screened pairs. In each case the conductors are of 200 lb. copper per statute mile.

To compete successfully in speed, accuracy, secrecy, cheapness, and continuity of service, submarine telegraph companies have always found it necessary to ensure that improvements in electrical equipment, cables, and methods of operation should have their counterparts in increased facilities for the reception of written or spoken messages from all sources, and for dispatch from terminal stations to all required destinations. To-day collection and delivery for the cable system here described are accomplished either (1) by private telephone wire direct between the person sending or receiving and the terminal station of the company; (2) by private telegraph wire; (3) by public telephone lines—local or trunk; (4) by branch offices in England, and others at Havre, Paris, Antwerp, Brussels, and Amsterdam; (5) by messengers organised to collect upon request; (6) by inland telegraph service utilising a pneumatic tube from the General Post Office; or (7) by pneumatic tube, or by telegraph, from the systems of other cable or wireless companies. The arrangements are now so far perfected that the time occupied from the instant of the reception of a message at the London station to its dispatch to New York can be reduced to a few seconds.

In general, although certain types of familiar equipment are becoming obsolete, basic principles are perpetuated in new designs. This is especially to be observed in repeaters and in recorders. Progress in cable design began with the reduction of electrostatic capacity; it extended by the introduction of loading. Efforts made to eliminate disturbances have led to the provision of special earthing devices; and, following upon what has been accomplished, renewed consideration is being given to the reduction of the resistance of the return path, through sea and sheathing, by means of supplementary conductors exterior to the core. Future generations may succeed in constructing transatlantic telephone cables, but at present the problem of design is unsolved—the time for transatlantic telephony by submarine cable is, therefore, not yet.

At this moment the most courageous step in submarine cable practice is represented by the decision of the Western Union Company to adapt loaded ocean cables to duplex working. The plan is so to modify the construction that the loading towards the ends is graduated. They have placed an order for such a cable to connect the Azores with Bay Roberts—a distance of 1,340 nms. About 160 nms. of cable at each end will be unloaded, and between each of these unloaded portions and the middle portion, of 740 nms., there are to be loaded sections in which the inductance is "tapered," each of 140 nms. Taking length and type into account, the traffic capacity of such a cable, when working duplex, is expected to be comparable with that of their existing loaded ocean cables. So long as enterprise of this character is in evidence, submarine telegraphy may be trusted to maintain its time-honoured leadership.

[An instructive I.E.E. paper on the design of submarine telegraph cables appeared in our issue of April 13th 1928, p. 664, and an article on disturbance elimination in our issue of April 6th, 1928, p. 591.—EDS. ELEC. REV.]

Printing Telegraphs on Submarine Cables.

In the *Journal* of the American Institute of Electrical Engineers for December, 1927, a paper by Mr. H. Angel on the use of printing telegraphs in connection with non-loaded submarine cables was abstracted. The author dealt with the improvements in apparatus and methods which had been adopted in the past with a view to increasing the speed of transmission, and discussed the characteristics of signalling codes, with reference to the use of telegraph printers. The operation of long cables by manual, semi-automatic, and full automatic systems was also described.

"Applications are Invited . . ."

The author, as the result of experience in selecting candidates for technical staff appointments, shows how applications should be drawn up.

By HUNTER FAICHNEY.

To deal with the replies received as a result of an advertisement in the Review is to learn that even first-class technicians are not always well qualified to market their own services.

It would be well if men who apply for staff posts could visualise the problem of the men whose commission it is to assist in the selection of the applicant who, in their opinion, is best fitted to fill the advertised duties.

Even at the first sorting of the few sheep from the many goats, when from hundreds of letters the really possible applications are selected for fuller consideration, many people who may have all the necessary experience and training are placed among the rejected because they have neglected to properly respond to the requests in the advertisement. The man who wrote that advertisement wrote it to express what, from his point of view, were likely to be the vital qualifications of the man he needed, and in all probability it asks for just the information he wants. To give him that information will interest him; and the prime purpose of your letter of application is to interest him. Get him interested in you by a letter brief and clear, but long enough to let him see that you have the qualifications called for, and he will be eager to read all about you.

During recent years several individuals have tried to foist themselves upon undertakers in the supply industry by fraudulent statements of educational qualifications, training, and experience they had no real claim to. In one notorious case, which ended in the law courts, an examination of some of the letters of application used showed that the applicant had repeatedly obtained posts in competition with men who had more than all the qualifications he himself wrongly claimed credit for. He had made a careful study of what the advertisers wanted, and he saw that they got it.

We all know of cases of men of unquestionable ability, eminently qualified to fill the desirable posts they seem so easily to obtain, and we are impelled to make occasional comparisons with men equally well qualified for advancement who are never able to get on to short leets and thus to improve the advantage so acquired. It becomes obvious that some technicians have had the good sense to give as much consideration to marketing their qualifications as they did to obtaining them.

Some time ago two men from the same technical staff applied for a municipal post advertised in the Review. The first was much the senior of the two, and had every possible qualification for the job. He was indeed a man of outstanding merit in his own line, which happened to be just the special feature of the advertised vacancy. His junior, a first-rate man, fully competent to carry out the duties advertised, but with only a fraction of the senior's experience and specialised technical training of the kind called for, got the job. The senior man did not even reach the short leet. The writer took advantage of an opportunity to examine the applications and saw that the Selection Committee could not but conclude that they had obtained the better man. Without overstating his case, the successful applicant had put all the goods in the window and made a first-class presentation of his qualifications. Getting a post is something of a salesman's job, and, judged as such, he deserved to get it. His colleague had simply underestimated the value of the material at his disposal.

Rarely does a manufacturer's representative have in hand a commission with such important possibilities to himself as has often a letter of application to aspirants for advertised posts. An order or contract that meant so much to the salesman would call for all the elaborate skill of his craft. When you take it in hand to proffer to employers the service you desire to place to advantage, you become for the time being your own representative with goods to sell in keen competition with other traders. It is a great quality in salesmanship to believe in your goods.

If you have the qualifications and the experience the advertiser asks for, he is just as anxious to meet you as you are to meet him. With a huge pile of letters of application to wade through, his one concern is to find you, if you are the right man, and as you have satisfied yourself that you are that man, you must see to it that your application is so constructed that he will put it with those set apart for fuller consideration.

Draw up your letter of application, after having properly appreciated the points of the advertisement. Write out in good sequence a statement of your special qualifications on the points mentioned: not a long-winded letter from which the information has to be sifted, but a simple statement, clear, lucid, and as brief as a properly complete presentation of the facts will allow. Unless handwriting is called for, the letter should be type-written on good paper.

The aim of the letter is to interest the advertiser sufficiently to lift your application from the ruck and ensure full attention to the accompanying matter. It is an introduction to the other necessary material which accompanies it, a connecting link between the advertisement and the detailed statement of your educational qualifications, experience, and training.

For the convenience of your auditors, be they Crown Agents, board of directors, selection committee, consulting authority, manager, or departmental head, the material accompanying your application should be placed between covers or binding sheets. Quarto is the best size, as it is more convenient to handle, and need not be folded if the particular vacancy applied for calls for much material, but may be posted flat.

On the outside of the cover, in the left-hand top corner, should be typed your name, and beneath it, down the centre, the numbered headings of the enclosed pages. Page one would be your letter of application, page two a list of dated periods of scholastic training, apprenticeship, and positions held up to date of applications; page three should contain the fullest possible information on your specialised experience and training in the duties the advertised post calls for. If this page is written with clarity you need not be afraid to overload it with data. Your letter and this page are the vital parts of your application. The paragraph under this heading may, of course, need more pages than one. Assuming that one page has sufficed, your fourth page should detail your educational qualifications and apprenticeship, the fifth your general training, the sixth your war service, and the seventh, copies of testimonials. If testimonials of recent date are asked for, send recently-obtained ones; if the advertisement says three, do not send six. Try hard to have testimonials that bear on the points mentioned by the advertising employer, and get them from people who are beyond all manner of doubt qualified to give the evidence they purport to give. Testimonials have taken on a new value in the supply industry since the events previously mentioned in this article. Other pages may be needed in special circumstances. Any one of the subject matters of the separate pages may, of course, come up for special consideration when the final selection is being made, and all should be prepared with a view to being read by busy men.

Presenting your case in its best light is quite a different thing from overstating it. If you are honest you will not overstate it; you will not be honest to yourself if you neglect material points.

Time-Limit Fuses.

A Simple Method of obtaining Approximate Time-current Characteristics of Time-limit Fuses.

By G. W. STUBBINGS, B.Sc.

FUSES have long been used to provide a time lag to the operation of an oil circuit breaker trip coil connected to a current transformer. Used in this way the fuse is connected in shunt to the trip coil and, normally, carries the greater part of the secondary current of the instrument transformer. When the fuse melts, the trip coil carries the whole of the secondary current, and as the trip gear is usually set to operate at a current considerably less than that for which the fuse is rated, the opening of the breaker follows immediately on the melting of the fuse. The time-limit fuse is usually considered to be inferior, in point of precision, to the induction over-current relay, and it has the further limitation that the time lag that it furnishes diminishes without limit as the current is increased. Moreover, a fuse cannot really be tested, since a complete test involves its destruction. The accuracy of the time lag given by a properly constructed fuse is, however, considerably greater than is usually supposed, and fuses which have been properly made up will, with the same current, give time lags so nearly identical that the differences can hardly be detected by stop watch measurements. The time/current curve of a time-limit fuse may thus be very useful if used intelligently, and the determination of this curve from a small number of experimental trials is a matter of considerable interest. To do this, an algebraic formula for the time/current is required.

The connection between the temperature of a fuse carrying a constant current and the time during which the current has been flowing can be expressed by a simple exponential formula, if the resistance of the fuse be assumed to remain constant. This expression is--

$$\tau = \tau_1 (1 - e^{-\frac{at}{s}}).$$

In this expression τ_1 is the steady temperature the fuse would assume if it did not melt, a is a heat-emission constant, and s is the thermal capacity of the fuse. At the steady temperature τ_1, i^2r is obviously equal to $a\tau_1$, and the above equation therefore becomes

$$\tau = ri^2(1 - e^{-\frac{at}{s}})/a.$$

If now τ be put equal to the melting temperature of the fuse wire, we have an expression connecting i and t,

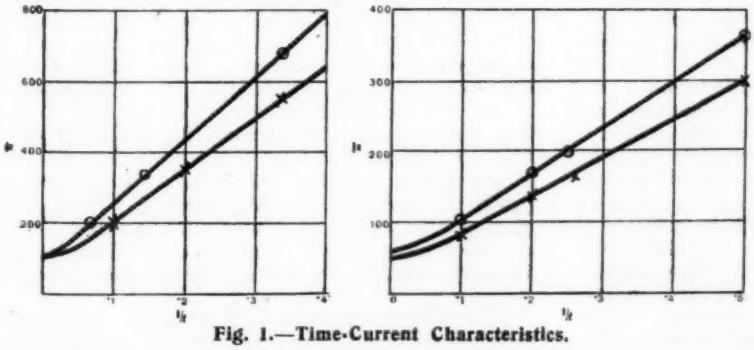


Fig. 1.—Time-Current Characteristics.

which neglects the heat required for the fusion of the wire.

When t is infinite, we have $\tau = ri_o^2/s$, where i_o is the maximum current the fuse will carry without melting. The equation can thus be written—

$$i_o^2 = i^2 (1 - e^{-\frac{at}{s}})$$

The exponential expression does not lend itself to easy calculation, but if we can obtain values of the current i_1 and i_2, the first of which gives a time lag one half of that of the second, we can eliminate the exponential by an obvious and well-known algebraic transformation, and obtain a simple expression for i_o, the limiting current—

$$i^2_o = 2i_1^2 - (i_1^4/i_2^2).$$

It is difficult to obtain the two values of the current, i_1 and i_2, required in this formula for the limiting current. Moreover, the time/current curve for moderate time lags is of even greater importance than a knowledge of the limiting current, since, in actual practice, it would be very unsafe to operate a fuse at a normal current which was not considerably less than this limiting current. It is therefore interesting to see if a simpler relation cannot be discovered, connecting i and t, which will enable the complete curve to be drawn with sufficient accuracy for practical purposes, from two sets of experimental values of current and time.

Examining the exponential equation, we see that, for very small values of t,

$\tau = i^2rt/s$, whilst in the limit τ becomes i^2r/a.

A simple algebraic expression which gives these two characteristics is

$$\tau = i^2rt/(s + at).$$

This curve is a rectangular hyperbola, and has the same slope at the origin, and the same horizontal asymptote as the corresponding exponential curve. This equation transforms to

$$i^2r - a\tau = s\tau/t;$$

with infinite t, $a\tau$ becomes $i^2_o r$, and we thus have

$$i^2 - i_o^2 = s\tau/rt = \kappa/t, \ \kappa \text{ being a constant.}$$

If this equation be correct, we shall obtain a straight line by plotting corresponding values of i^2 and $1/t$ from the time/current characteristic of a fuse, and the intercept of this straight line on the i^2 axis will give i_o^2, from which the limiting value of the current can be obtained.

Two experimental sets of values of i and t would be sufficient to enable the i^2 and $1/t$ curve to be drawn, and from this curve the usual characteristic could be at once obtained.

We can obtain an expression similar to the one foregoing, on rational grounds, by writing down a "heat balance" equation for the time during which the fuse carries current. The heat produced by the current is i^2rt, the heat lost by radiation and conduction is $a\tau t$, τ being the average temperature over the whole period, and, finally, the heat required to melt the fuse is a constant quantity η. We thus have

$$i^2rt - a\tau t = \eta, \text{ or } i^2 - i_o^2 = \kappa/t,$$

an expression of similar form to that obtained above.

We have tested the above formula by plotting corresponding values of i^2 and $1/t$ taken from representative time/current curves for time-limit fuses, given in manufacturers' technical pamphlets, and it is found that these values lie very approximately on a straight line, excepting for very small values of $1/t$. The value of i_o^2 given by the intercept of the straight line on the i^2 axis is in all cases too low. Some of these curves are given in fig. 1, from which it will be seen that a perceptible upward bend takes place for small values of $1/t$.

The reason for this discrepancy will be easily understood from a consideration of the "heat balance" equation, $i^2r - a\tau = \eta/t$.

For very large values of t, the average temperature τ will approximate to the fusing temperature. For short times, however, the average temperature may be of the order 2/3 of the fusing temperature. This difference is shown in fig. 2, in which two heating curves are drawn, the one giving a relatively large and the other a small time lag. A glance at these curves shows that the average temperature of the fuse during the time that it carries current is much greater in the first than it is in the second case.

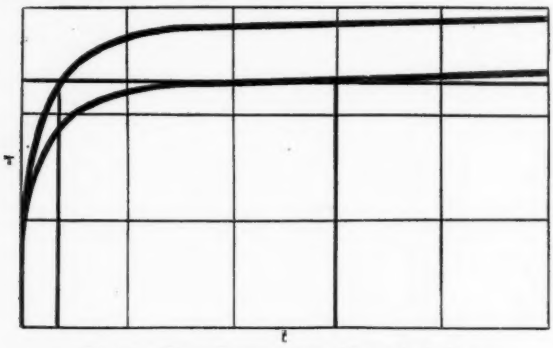


Fig. 2.—Time-Temperature Characteristics.

The approximate straight line relation between i^2 and $1/t$ thus enables the time/current characteristic to be obtained for all but very long time lags, from two experimental determinations. The approximate formula gives an inaccurate value of the limiting current, but it is to be noted that this value is less than the actual value, and is one which can therefore be adopted with safety. A closer approximation for the limiting current can be obtained by reading off, from the straight-line graph of i^2 and $1/t$, two values of i^2 for time lags, the one of which is double of the other. The value of i_0 obtained from the equation $i_0^2 = 2i_1^2 - i_1^4/i_2^2$ will only be the same for all values of t, when the relation between i and t is an exponential one. It will be found, however, that, if the values of i_1 and i_2 are chosen, from the linear graph of i^2 and $1/t$ for values of t which are not too large, but sufficient to have been determined with fair accuracy, say 5 and 10 seconds, a very good approximation of the value of the limiting current will be obtained. Reading off values of i^2 from the curves in fig. 1a, we obtain from the upper graph $i_1^2 = 430$, and $i_2^2 = 250$, and substituting these values we obtain—

$$i_0^2 = 860 - 742, \text{ whence } i_0 = 10.9 \text{ A.}$$

The fuse to which this graph applies is rated at 10 amperes. From the lower graph of fig. 1a we obtain the values 345 for i_1^2 and 200 for i_2^2, from which $i_0 = 9.8$ amperes, a better approximation. Taking the top graph of fig. 1b, we obtain a value of 7.4 amperes for a fuse rated at 7½ amperes. We have already drawn attention to the fact that the exponential expression for the time/current characteristic of a fuse is based on an erroneous assumption, and it is hardly possible that anything more than an approximate value for the limiting current of a fuse can be obtained by calculations based on experimental values of the current for moderate time lags.

N.R.E.I.C. or E.C.A.?

A Review of the Amendments and of the Executive's Attitude.

By H. R. TAUNTON.

THE recently issued report of the Executive Committee of the National Register of Electrical Installation Contractors makes an interesting allusion to the various criticisms of the Register which have from time to time appeared in the technical Press and dismisses them, with a complacency which most contractors will think misplaced, with the words, "very little is called for in the direction of meeting these criticisms." After such an expression of opinion it is not surprising to find that "very little" has indeed been done, nor, apparently, need we expect much more to be done in the future, "in the direction of meeting these criticisms."

Actually, so far as the proposed amendments to the rules and regulations go, the only important ones are in the qualifications for registration. The possession of "suitable premises," which before was only called for at the discretion of the Committee, is now made compulsory; and the applicant must be engaged in business "on a scale which shall fulfil the ordinary meaning of the term 'Installation Contractor.'" At the discussion at the annual meeting, Mr. Purse wisely declined to commit himself to a definition of "the ordinary meaning of the term 'Installation Contractor.'" It is to be feared that so elastic a phrase, left to the interpretation of the local committees, will often be stretched out to invisibility, or alternatively contracted to vanishing point.

Another amendment allows the Executive Committee at its discretion to require an applicant to produce satisfactory evidence of his standard of workmanship, subject to inspection; and a grantee may now be removed from the Register, not only for bad workmanship, but for the use of poor material. In this connection it is interesting to note that, if a complaint is made against him, he may now be called on to produce specifications and other documents as evidence of the quality of his material. The remaining amendments are mainly to details of organisation and procedure.

Of those quoted above, that penalising the use of shoddy material is certainly a desirable one; and if it is strictly enforced it will meet at least one point of recent criticism. But will it ever be more than a pious aspiration? Who is going to enforce it, and how?

I observe that out of 1,177 applications registered up to the end of 1927, only *two* have been cancelled for "bad workmanship." How many are likely, then, to be cancelled for bad material, a factor always so much less obvious to the casual eye? The Committee, of course, can argue that the fact that cancellations have been remarkably few in the past is due to the high qualifications demanded and the closeness of their scrutiny. That would be plausible; but not very convincing to the practical contractor, who every other day comes across glaring examples of bad workmanship which, unless registered contractors are still in a small minority, must in many cases, by the law of average, have been perpetrated by some of them.

Alternatively, the Committee can argue that cancellations are few because complaints are few; but that would only be to confess one of the weaknesses of the organisation, a weakness which would be largely obviated were the local committees stronger. Which means—however much the ruling powers may dislike the idea—if they were composed of practical men, mainly or wholly contractors.

Here we get to the heart of the whole trouble. Are the contractors to have the voice in the working of the Register to which their preponderating interests entitle them? Mr. Purse says "No." He tells us we are

"fatuous" and "puerile" to suggest that those who pay the piper should call the tune. The present report endorses the substance of his recent article in the ELECTRICAL REVIEW. The many and oft-repeated criticisms of the Register, we are told, may be ignored because they are based on the mistaken assumption that it is a trade organisation, and that contractors by becoming registered, become entitled to require the Register to be conducted in their interests. "The National Register exists primarily for the purpose of protecting the public."

That profession of faith makes the two new amendments imposing additional qualifications—the possession of suitable premises, and of a business on a reasonably large scale—seem somewhat inconsistent. No contractor will quarrel with them, for they tend to relieve him of the competition of small men who are without his handicap of "standing charges"; but simply from the point of view of the public, they are unessential. All the public looks for in a contractor is competence; and that is a matter only of honest skill and experience, and has nothing to do with his financial standing.

No reputable contractor wants the Register conducted "purely"—the word is that of the report—in his interests, to the neglect of those of the public. The suggestion that he is so selfish, so unscrupulous, so shortsighted that he cannot be trusted to consider the public weal, underlies the whole of the Committee's comments on its critics, as it did Mr. Purse's recent article and letter in their defence. It is as unjustifiable as it is absurd.

Any register which defines the status of contractors and sets an adequate standard of workmanship, cannot fail to benefit the public if it be properly conducted, whether by outside bodies or by the contractors themselves. Its virtue lies in the fact that it is a Register, a test of qualification. It does not depend in any way on the prestige of its "founders," however august, as we are asked to believe.

The public would not be a whit the worse off—and how many would care a button?—if the Register were transferred to-morrow, lock, stock and barrel, to the control of a body affiliated to the E.C.A. They could, indeed, scarcely be worse off; for the gist of recent criticism is that the Register is not effective in protecting their interests. Only a strong Register can do that; and if the Executive Committee continues to turn a disdainful ear to the contractors who would have it mend its ways, a strong Register we shall never have. If it is so satisfied with things as they are, obviously it will make no attempt to improve them. The best we may expect is some vague promise such as it makes after excusing, on the score of "unexpected difficulties," its failure to expend any specific amount on special publicity. It tells us that it hopes "to be able to overcome these difficulties in the near future." Always "jam to-morrow"! Incidentally, what would be thought of a business firm which allowed "difficulties" to delay its advertising throughout a whole twelvemonth?

We cannot hope that the N.R.E.I.C. will ever shake off its present apathy so long as its Executive Committee smothers all criticism with the retort: "Oh, it's only you contractors who grumble—and *your* grumbles don't matter. The Register's no business of yours, anyway!" Nor, so long as it refuses to admit that the voice of the contractor, though numerically weak on the Board, is the one voice that really matters. The interests of the other "Founding Bodies" are purely academic; *his* interests are vital. If they be ignored, so that he is left dissatisfied, the present state of stagnation can only end in decay and dissolution.

It is surely axiomatic that a Register of contractors cannot exist without contractors. If they—those that matter—desert it, the "Founding Bodies" would be left in the air, looking rather foolish. It is not a possibility they can afford to ignore. At present, though they grumble at it, the contractors loyally support it, hoping that, poor as it is, it will yet prove a stepping stone to something better. They realise, as well as do those who lecture them from on high, that some sort of Register is desirable in the interests of the public; and so, although as it is to-day conducted, they can see in it no definite advantage to themselves, they bolster up the only organisation that is in being, with a public spirit which they are curtly told must be its own reward, always as now.

How many would continue to do so if to-morrow the E.C.A. were to take the bull by the horns and, reflecting the widespread dissatisfaction with the N.R.E.I.C. of its members, were to organise, directly or indirectly, a rival Register? How many firms of standing would remain on the roll of the "National" Register if they had a live Register of their own in whose policy they would have a reasonable voice?

Since Mr. Purse asks for constructive criticism, I offer *that*, as a not impossible alternative to the *laissez faire* of the N.R.E.I.C. and the discontent of its members. To such a Register, under the *ægis* of the E.C.A., there are perhaps objections, but they are minor; and there might be difficulties, but they would not be insuperable. On the other hand, there would be compensating advantages, many and great: not least that of control by practical men with an active interest in a strong Register, an inclusive and progressive Register. a Register run by contractors for contractors; and which, withal—since altruism is the keynote of the defence—would certainly be of no less benefit to the general public that the present Register aspires—and fails—to be.

E.A.W. Conference.

The third annual general meeting and conference of the Electrical Association for Women was held on April 17th and 18th. For the first time the deliberations took place in the theatre of the Institution of Electrical Engineers, and the facilities which were afforded to the Association in that connection were much appreciated. The annual report was presented by Miss C. Haslett, director, E.A.W., who outlined the progress made during the past year by the Association as a whole and also by the branches. Expressions of confidence in the Association and support for its work, she said, had been received from many esteemed authorities, including kindred electrical associations. The following officers were elected for the coming session: President, Mrs. Wilfrid Ashley; hon. treasurer, Mrs. Llewelyn B. Atkinson; chairman of the council, Alderman Mrs. Hammer; and vice-chairman of the council, Mrs. S. Z. de Ferranti. Mrs. Ashley made a very interesting and charming speech on her election as president.

During the afternoon of the first day of the conference, the members visited the London Light Clinic, where all the latest methods and apparatus for treatment by light and inhalation were described and explained by Dr. Deck. In the evening a ball was held at the Hotel Cecil, where Mrs. Ashley received over 240 guests. The ball was a great success, and the cabaret was very much appreciated. The next morning the electrical installation at the Zoo was inspected by members attending the conference, the party being shown round by the Zoo engineer, Mr. E. A. Davolles. An interesting and witty lecture was given in the afternoon by Captain P. P. Eckersley on "Some Problems of Broadcasting"; Lady Brooks, C.B.E., J.P., president of the Birmingham and Midlands branch, was in the chair.

It was regretted that, owing to the limited time for the conference, the contemplated discussion on the new Electrical "Outlet" Campaign had to be abandoned. It was agreed to accept the invitation of the North-East Coast branch of the Association to hold the 1929 Conference at Newcastle-on-Tyne during the period of the North-East Coast Exhibition.

Great credit is due to Miss Haslett for the excellent manner in which the meetings, visits and the ball were organised and carried out, and her efforts were very highly appreciated by all who took part in the conference.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The New International Finance Combine.

The new Finance Company of Great Britain and America represents an alliance of British and American industrial and banking interests on an unprecedented scale. In it the largest single producing unit in the British Empire—Imperial Chemical Industries, Ltd.—is allying itself with the biggest banking interests in the United States—the Chase Securities Corporation of New York and the Chase National Bank. The chemical combine has a capital of £65,000,000, and includes over a hundred companies with branches, factories, agencies, &c., all over the world. The Chase Securities Corporation has over 4,000 branches, and commands assets amounting to £200,000,000. Several prominent industrialists and financiers are directors. Sir Alfred Mond is chairman, and Sir Harry McGowan deputy chairman, while Mr. C. Graff and Mr. J. H. Gannon will be joint managing directors. The nominal capital of the new company is £2,040,000, but through its associations on both sides of the Atlantic the company will have a backing of no less than £500,000,000 in capital and credits. The functions of the company are not those of the usual investment trust. They will be directed to the development of new processes and the increase of production. The development of large industry in this country has not taken place to such an extent as in such countries as the United States and Germany. The movement for the rationalisation of industry has grown considerably during the last few years. By creating the new company facilities which were lacking before are now to be provided, it is stated.

"Wild-Barfield" Furnaces Abroad.

AUTOMATIC & ELECTRIC FURNACES, LTD., informs us that "Wild-Barfield" electric furnaces are being exhibited at the Ninth International Samplers Fair, Milan, the Convention of the Foundry Industries of Spain, Barcelona, and the Paris Fair. In France and Italy the furnaces are made by the company's licencees in those countries.

Brush Football Success.

The BRUSH ELECTRICAL ENGINEERING CO.'S SPORTS CLUB football team was successful in winning the final tie of the Leicester F.A. Junior Cup Competition on Easter Monday, when it defeated Ibstock Penistone Rovers by 3 to 2, after a very even game.

Stoker Contracts.

Among the orders recently received by Messrs. E. BENNIS AND CO., LTD., are several for chain-grate stokers from electricity supply authorities, including Sheffield, Ashton-under-Lyne, Wakefield, Bury, Kingston (Isle of Wight) and the City of London Electric Lighting Co., Ltd.

The Industrial Peace Conference.

The conference on Industrial Reorganisation and Industrial Relations, composed of the Representative Group of Employers and the General Council of the Trades Union Congress, has already reached agreed statements on a number of items on the agenda. In view of the urgency of the matter, it was decided to communicate immediately an agreed memorandum on the gold reserve and its relations with industry to the Chancellor of the Exchequer.

New Chinese Patent Regulations.

By an Order issued last month, the Chinese Ministry of Industries promulgated a set of detailed regulations governing the enforcement of a Patent Law, which contain the following important points:—The application for a patent right and the explanatory note attached thereto should be written in the national (Chinese) language, and any foreign technical term therein should be accompanied by a translation in Chinese. In the explanatory note should be stated: (1) the name of the invention or newly-discovered, improved method of manufacture; (2) its purpose and scope; (3) its manufacturing processes and method of operation, if it is a mechanical instrument; and (4) the scope and time-limit of the patent right applied for. In cases where the object for which a patent right is applied for is a mechanical instrument, the applicant should accompany his application by the invented machine or a model, together with detailed illustrations; patent rights may be applied for by representatives. In case of application for prohibition of imitations, the applicant should give a detailed account thereof and submit the imitation articles in question for examination.

New Italian Companies.

Among the concerns recently formed in Italy in connection with the electrical industry are the Società Costruzzioni Impianti Esercizi Telefonici, Venice, capital 600,000 lire; and La Società Officine Reparazioni Motori Elettriche Impianti, Milan, capital 25,000 lire.

The National Radio Exhibition.

We have received from the organisers, the Radio Manufacturers' Association, Astor House, Aldwych, W.C.2, a number of documents concerning the National Radio Exhibition which is to be held at Olympia from September 22nd to 29th. These include the form of contract for stand-holders, particulars of, and charges for, stands, a plan of the hall and stands, &c. As before, the Association has arranged a competition for poster designs advertising the exhibition. Six prizes, ranging from £50 to £5, are offered, and sketches must be sent in by May 31st.

New French Company.

A company has been formed in Dunkirk, with a capital of 10 million francs and the title La Société Dunkerquoise d'Electrochimie, to establish works for the manufacture of electrochemical products.

The Victoria Falls Concession.

The North Rhodesian Government has announced that as the Victoria Falls and Transvaal Power Co., Ltd., has not exercised its privileges under the concession for the development of the Victoria Falls granted to it in 1906, the lease is invalid. The Government states that it is prepared to consider any scheme for the harnessing of the Falls, which are estimated to have a potential development of 250,000 h.p. The V.F. & P. Co.'s neglect to proceed with the development is due to the fact that the nearest market for the power—the Rand—is 700 miles from the Falls. It is said that the company has under consideration a scheme for supplying electricity to Northern Rhodesia, and that if the Government persists in its attitude recourse will be had to the Courts to test the validity of its action.

Sub-Station Equipments.

In connection with the progress of railway electrification in Australia, additional electrical equipment for sub-stations has been ordered from the British Thomson-Houston Co., Ltd., Rugby. This plant is required in connection with the Sydney suburban scheme of the New South Wales Government Railways, and includes B.T.-H. transformers, rotary convertors, and automatic starting equipments. The transformers will reduce the e.h.p. bulk power supply, in some cases from 33,000 V and in others from 11,000 V, to a voltage which, applied to the rotary convertors, will enable these machines to feed the track at 1,500 V. There will be 16 single-phase transformers, each rated at 1,100 kVA, and ten 1,500-kW, 750-V rotary convertors, which will be connected two in series so as to give 1,500 V. B.T.-H. rotary-converter plant aggregating 45,000 kW is already installed in connection with the Sydney suburban electrification scheme, so that when the equipment just ordered is installed the total will be 60,000 kW.

Among other orders of interest received by the same company is one from the Calcutta Electric Supply Corporation, Ltd., India, for a 2,500-kW, 6,000/450- to 500-V motor-convertor with suitable starting equipment, and one for the complete electrical equipment for 15 sub-stations, through which electricity for domestic and industrial purposes will be provided in Colombo, Ceylon. There is already an electrical supply in Colombo, but a reorganisation and large extension of the area in which electric power is available is taking place; the plant which the B.T.-H. Co. is now to supply includes 20 three-phase, 50-cycle transformers, each of 100-kVA rating; three of 280 kVA; three of 500 kVA; and one of 750 kVA; also three rotary convertors of 250 kW each, and a 667-kVA frequency changer to give a single-phase, 60-cycle supply.

Catalogues Wanted in Selangor.

Mr. J. HALLIDAY BORLAND, chief engineer to Rawang Tin, Ltd., Rawang, Selangor, F.M.S., desires to receive copies of all catalogues and lists dealing with the following and allied products:—Power station equipment (steam), h.p. 6,600 volts, 3-phase, 50 cycles; paper-insulated, lead-covered cables, plain and armoured, h.p and l.p.; ditto trailing cables; induction motors, switches and starters, &c.; house-wiring material; engine-room stores, tools, &c.; and a.c. meters.

A Swedish Cable Development.

It is announced that the L.M. Ericsson Company, which has been in close touch with Sieverts cable works, of Sundbyberg, in recent years, has now definitely arranged to take over the whole of the shares in the latter undertaking as from July 1st. The Ericsson Company already owns a cable factory in Alvsjo, and with the addition of the other factory the total productive capacity will be trebled. The Sieverts cable factory was started in 1888, and is claimed to have gradually developed into one of the chief cable factories of Europe.

Registered Electrical Contractors.

At a meeting of the Executive Committee of the National Register of Electrical Installation Contractors on April 13th, the following applications for registration were accepted :—

Charlton, C., Monkseaton, Northumberland.
Dennison, W., & Son, Clapton, E.5.
Murt, William F. R., Falmouth.
Tong, C. E., York.
Green, A. E., Amble, Morpeth.
Urmston Electrical Co., Nr. Manchester.
Hicks' Electrical Installations, Birmingham.
Sykes, W., & Sons, Darlington.
Dowling & Primavesi, Ashford, Kent.
Economic Electrical & Mechanical Engineering Co., Cardiff.
Electrical Maintenance Co., Wallington, Surrey.
Bacon, V. E., London, W.1.
Keating & Rumens, Winchmore Hill, N.21.
Cooper, R. G., Cardiff.
Southey, H., & Co., London, N.8.
Dunbar, P. J. P., Great Yarmouth.
Mitchell, E., Halifax.
Thomas, Bertram, Hulme, Manchester.
Parker, W. B., Leeds.
Hamer & Co., Ltd., Halifax.

At the same meeting two applications were withdrawn and five were declined.

Visit of Italian Students to Osram Works.

A party of 63 Italian students visiting London under the auspices of the Ministry of Education in Rome paid a visit on April 20th to the Osram G.E.C. Lamp and Valve Works at Hammersmith. They were in charge of Prof. Comm. Bruno Vignola, four other professors, and two or three English ladies speaking fluent Italian, who acted as interpreters. After spending the morning touring the works, they were entertained to luncheon at the Clarendon Restaurant, Hammersmith Broadway. Mr. C. Wilson presided, and after our own loyal toast had been drunk, that of the King of Italy (coupled with the name of Signor Mussolini) was also given. Mr. Wilson extended to the party a hearty welcome on behalf of himself and the company. He made reference to the fact that our Italian friends had struggled side by side with us for national independence, and said he felt that our international relationship would benefit greatly if more visits of this kind could be arranged. Professor Vignola, representing the Ministry of Education in Rome, responding on behalf of the Italian students, expressed his appreciation of the hearty welcome accorded them. He said they had been greatly impressed by what they had seen, and that the tour of the factory had brought to their minds in a most convincing way an aspect of British industrial life which would remain in their memory for a long time to come. He thanked Mr. Wilson for the hospitality extended to them, and wished the company every prosperity. Miss Taussig ably acted as interpreter.

Trade Announcements.

The title of the company A.E.G. MACHINERY & APPARATUS CO., LTD., has been altered to A.E.G. ELECTRIC CO., LTD., a name that was familiar here in pre-war days.

LONDON METAL WAREHOUSES, LTD., Hill Street, Blackfriars Road, S.E.1, has recently purchased the Lancaster Brass Foundry, Lancaster Street, S.E.1.

MESSRS. JOSEPH KAYE & SONS, LTD., Leeds, have recently received a repeat order for 800 of their patent locks from the L. & N.E. Railway. They also have in hand important orders for the Metropolitan Electric Supply Co., Ltd., and the Yorkshire Electric Power Co.

A radio business has been opened by Mr. M. SMITH, under the style of the County Radio Co., at 84, Eden Street, Kingston-on-Thames.

MESSRS. FITTER & POULTON, LTD., of Birmingham, have appointed Mr. J. Campbell-Sparrow, 35, Clyde Street, Motherwell, as their agent for Scotland.

New Catalogues and Lists.

VOLTA, LTD., Kern House, 36-38, Kingsway, W.C.2.—The "Viewpoint" for April, containing selling hints and notes on "Volta" vacuum cleaners.

HIGGS MOTORS, Witton, Birmingham.—A comprehensive catalogue of a.c. and d.c. industrial motors, containing full details and reduced prices.

THE VICTORIA ELECTRIC PLANT CO., LTD., Spenser Street, S.W.1.—An illustrated price list of "Lucette" lighting fittings, for which the company is sole agent for London, the Home Counties and Southern England.

MESSRS. NEWTON & WRIGHT, LTD., 471-473, Hornsey Road, N.19.—A publication illustrating and describing the "Holway" dual control unit for rapid radiography. Priced.

ST. HELENS CABLE & RUBBER CO., LTD., Slough, Bucks.—A booklet containing lists and illustrations of important buildings and difficult positions in which the company's c.t.s. cables have been installed.

THE BENJAMIN ELECTRIC, LTD.—A folder illustrating the use of "Benjamin" reflectors for factory lighting.

CANTIE SWITCHES, LTD., Leighton Works, Carlton Road, Nottingham.—Folder indicating their "Cantie" range of distributive switchgear.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Price List No. 4153, a pamphlet describing and illustrating oil-immersed circuit-breakers for a.c. circuits at pressures not exceeding 3,300 V.

MESSRS. FERRANTI, LTD., Hollinwood, Lancs.—Pamphlets Fa 100, Fb 75, and Fb 76, containing illustrated particulars of "Nomag" non-magnetic cast-iron and manufactures thereof, such as resistance grids, machine end shields and plates, and switchgear frames.

THE MARCONIPHONE CO., LTD., 210-212, Tottenham Court Road, W.1.—A coloured poster advertising the company's deferred-payment system for its two-valve receiving set.

PAN-ELECTRIC, LTD., 78, Fleet Street, E.C.4.—Illustrated pamphlets dealing with the manufactures of the Ganz Electric Co., Budapest.

THE CARRINGTON MANUFACTURING CO., LTD., Sanderstead Road, South Croydon.—An illustrated and priced leaflet advertising "Camco" cabinets for portable radio sets and loud-speakers.

THE VISCO ENGINEERING CO., LTD., 162, Grosvenor Road, S.W.1.—A pamphlet dealing with the construction and employment of the "Visco-Beth" tube filter for dust collection.

LIBRACO, LTD.—A pamphlet containing illustrated particulars of the company's office equipment.

MESSRS. WILLIAM GRIFFIN & SONS, LTD., Cradley Heath, Staffs.—A booklet illustrating and describing "Triton" chains for lifting and hauling.

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—An illustrated folder containing details and prices of the company's signs for the brewing and catering trades.

MESSRS. P. ORMISTON & SONS, LTD., 79, Clerkenwell Road, E.C.1.—A card detailing the scope of the company's wire manufactures.

Bankruptcy Proceedings.

R. M. COLLIER, 273, Moss Lane, East, Moss Side, Manchester, lately 138, Ashton Road, Oldham, electrician and electrical contractor.—The public examination of this debtor was held and closed on April 18th at Oldham. The statement of affairs showed ranking liabilities of £140, against assets of £77. Debtor commenced business in September, 1924, with £50 cash capital. He further commuted part of his army pension for £163, and in December, 1925, he purchased premises by means of a mortgage. He carried on business until June, 1927, and from then until January, 1928, he left the business to his wife whilst he obtained other employment. The net profits were insufficient to provide for outgoings and household and personal expenses. Debtor had resorted to moneylenders, the money borrowed being used entirely for business purposes.

A. H. CRUMP, trading as the Selwyn Electrical Engineering Co.), Walworth Road, and Hawkslade Road, Peckham Rye, S.E.—The public examination of this debtor was held last week before Mr. Registrar Warmington, at the London Bankruptcy Court, the accounts showing liabilities of £733, and assets valued at £117. The debtor stated that in March, 1905, with £150 capital, he started an electrical contractor's business under the style of "Selwyn Electrical Engineering Co." In June, 1923, during the "wireless boom" he acquired a seven-year lease of 202, Walworth Road, refitted the premises with £250 borrowed money, and transferred the business to that address; he then began to deal in wireless sets and parts; for two months after commencing this trade he was away ill and the business suffered from bad management. In 1926 he tried unsuccessfully to obtain a partner with capital, or a purchaser of the business, which went from bad to worse. On February 17th, 1928, when execution on his effects was threatened, he sold the business for £150, handed the money to his solicitors, and filed his petition. The debtor attributed his failure and insolvency to lack of capital, keen competition, and family illness. The examination was concluded. The following are creditors :—

	£		£
F. Crump	250	S.D.H. Mfg. Co., Ltd. ...	24
Gottlieb & Co., Ltd. ...	28	Sunlight Mfg. Co. ...	62
Southwark Electrical Department	23	Telephone Berliner, Ltd.	22
Lithanode Co., Ltd. ...	30	Vulco Co., Ltd.	20
Metalite, Ltd.	47	J. Francis	38

A. C. COOPER, 1a, Sherwood Street, Scarborough, electrical engineer.—The public examination of this debtor was held on April 17th at the Court House, Scarborough.—The statement of affairs showed gross liabilities of £1,153, all of which were expected to rank for dividend, with a deficiency estimated at £1,027. Debtor attributed his failure to bad trade during the last two years, keen competition, lack of capital, and losses on contracts. He had borrowed £860 from his father-in-law during his trading career, which the latter did not intend to prove. He made a profit for a time, but during the last three years had sustained losses. The hearing was closed.

H. A. HYDE, 148, Weston Park, Crouch End, N., late of Bromley, Kent, radio dealer.—The receiving order herein was made recently on debtor's own petition. The ranking liabilities amount to £570, and there is a deficiency of £512. Debtor attributed his failure to lack of capital, bad debts, trade being insufficient to meet overhead charges and depreciation of stock. About 1922 he was appointed a director of a limited company and acquired 250 £1 shares—100 for cash, which was given to him by his parents, and 150 which were allotted to him as fully paid in respect of his knowledge of the business. In 1923 he left the company, and it had since ceased trading In September, 1923, he, with £30 capital, and stock of the value of £60 given to him by his father, commenced business in his own name as a dealer in radio apparatus. Debtor admitted having been aware of his position since June, 1927, since when most of the present trade liabilities have been contracted.

C. NICHOLSON, electrical engineer, 3, Lorne Terrace, East Bolden, Durham.—The public examination of this debtor was held recently at the Court House, Sunderland, when the hearing was adjourned. The deficiency amounted to £625. Debtor attributed his failure to loss on contracts, depression of trade, and the general strike of 1926.

J. B. WICKSTEAD, R. J. ALLEN, and L. KNIGHT (C. Cooper and Co.), electrical engineers, &c., 26, King Street, Stretford.—Trustee, Mr. A. T. Eaves, 47, Mosley Street, Manchester, appointed April 17th.

A. J. CULLUM, motor and electrical engineer, 8, Church Street, Diss.—Trustee, Mr. H. S. Gotelee, Official Receiver, 9, Arcade Street, Ipswich, released April 11th.

W. J. WARREN (Coleman & Warren), wholesale electrical supplies, 66, Victoria Street, S.W.—First and final dividend of 3d. in the £, payable at Carey Street, W.C.

H. E. OSBORN, wireless dealer, 3, High Street, Normanton.—Receiving order made April 12th, on debtor's own petition. First meeting April 27th, at the Official Receiver's office, County Chambers, King Street, Wakefield. Public examination May 10th, at the Court House, Wakefield.

O. L. JONES (Jones & Evans), wireless dealer, Castle Buildings, Pontardulais.—First meeting held April 24th, at the Official Receiver's office, 4, Queen Street, Carmarthen. Public examination May 8th, at the Guildhall Carmarthen.

R. HILTON, electrical engineer, 81, Blackburn Street, Radcliffe.—Trustee. Mr. S. A. Mayers, 16, Silverwell Street, Bolton, appointed April 12th.

E M. LANCASTER, electrical engineer, 21, Hanover Lane, Leeds.—First and final dividend of 1s. 11½d. in the £, payable April 27th, at the Official Receiver's office, 24, Lower Bond Street, Leeds.

Company Liquidations.

GENERAL RADIO CO., LTD., Regent Street, S.W., and Bravington Road, W.9.—A meeting of creditors was held on April 18th, at Caxton Hall, Westminster. The chair was occupied by Mr. P. S. Booth, Kimberley House, Holborn Viaduct, E.C., liquidator. Mr. Booth said that there was not the slightest hope of any dividend being paid to the unsecured creditors. A receiver for the debenture holders had been appointed, and he (Mr. Booth), in conjunction with some of the principal creditors, made every effort to find a buyer for the business as a going concern at a price which would have allowed some dividend to be paid. Those efforts were unsuccessful. The company was incorporated in June, 1923, with a nominal capital of £30,000, and £21,000 had been allotted, and was fully paid. The directors at the date of liquidation were Messrs. Arthur Morphy (chairman), W. S. Stephenson (managing director), W. E. S. Wissler, B. H. Morphy, and D. W Morphy. The total liabilities to trade creditors were approximately £61,700, and there were, in addition, debentures and interest outstanding of £19,987. A private conference of the larger creditors was held on March 14th, at Anderton's Hotel, Fleet Street, E.C., following the appointment of a receiver, and the presentation of a petition for the compulsory liquidation of the company. The petitioning creditors were then asked to apply for their petition to be adjourned for a month, as negotiations were pending for the sale of the company's assets, and a committee of the principal creditors was appointed. The adjournment was agreed to, and the committee had several meetings, and considered various schemes for the reconstruction of the company. None of those schemes, however, had matured, and the company was requested to go into voluntary liquidation. The receiver had submitted an offer to the Court of £6,400 for the assets, but it was not accepted. On April 4th last an offer of £10,000 was made for the assets of the company, and was confirmed by Mr. Justice Clauson. Apparently the sale price of £10,000 would hardly liquidate the amount due to the receiver, irrespective of the sum owing to the debenture holders. In the last balance sheet the assets were valued at £118,000. It would appear that book debts were owing by hirers all over the country. Most of the hirers had made complaints regarding the receiving sets. Most of the hirers were paying by instalments, and had been returning sets at the rate of 1,000 to 2,000 per week. He was informed by the receiver and the solicitor to the company that the County Court Judge took a certain view in the majority of cases, when a complaint was made regarding the inefficiency of the apparatus, the Judge deciding that until the set was put into proper working condition no order for payment would be made. It was quite apparent that the receiver who wanted £20,000 in respect of debentures and interest would not have sold the assets for £10,000 if he had thought that the book debts were recoverable. In reply to a question, he said that the Triumph Trust, Ltd., was the purchaser. Mr. W. J. Palmer, of the British Electrical Co., said that he understood that there were about £150,000 worth of contracts outstanding. Mr. Palmer remarked that when another firm was considering the purchase of the assets, the price suggested was £30,000. He understood that it only cost about 25s. to put each set into proper working order. There were 20,000 sets outstanding, and if they were put in order a great deal of money would be made. Mr. Allen remarked that creditors had understood that the business was a "gold mine." He suggested that the creditors might consider the advisability of funds being found to purchase the business from the Triumph Trust, and carry it on. A resolution was unanimously passed confirming the voluntary liquidation, and a committee was appointed consisting of the representatives of Messrs. G. Street & Co., Ltd., Electron Co., Ltd., Beco, Ltd., H. Yager, Ltd., Allen Craig, H. King & Co., H. Clarke & Co., and Bovis, Ltd. Mr. Booth intimated that the committee would consider with him the suggestion which had been made by Mr. Allen, or any other scheme, and, if necessary, communicate with the creditors later. The principal creditors are:—

	£		£
Electron Co., Ltd. ...	8,000	McMichael, L., Ltd. ...	425
Thompson, J. W., Ltd.	500	Metropolitan Elec. Supply Co.	435
British Electric Sales Co.	4,250	Kent Bros. Electric Wire Co.	1,400
Bristol, W. K., & Co., Ltd.	640	King, H., & Co. ...	1,900
McEwan's Cabinet Works	750	Wallace & Attwood ...	880
MacMillan, Jas., & Co.	800	Bovis, Ltd.	1,500
Craig, Allen	3,000	Clarke, H., & Co. ...	1,300
Marconi Co.	904	Yager, H., Ltd.	1,568
Street, G., & Co., Ltd.	18,000	Beco, Ltd.	3,700
Thames Board Mills, Ltd.	724	Solidite & Synthetic Mouldings	1,180

HERRICK, DURELL & CO., LTD., 92, Park Street, Camden Town, electrical engineers and contractors.—The statement of affairs filed in the compulsory liquidation of this company shows total liabilities of £2,973 (£2,446 unsecured), and no assets. The following are creditors:—

	£		£
All. M. Building Co. ...	57	Jackson & Smith	500
Anglo-American Oil Co., Ltd.	22	Jones, J.	21
Bush, W.	140	King, B. F.	98
Edison Swan Electric Co., Ltd.	27	London Electrical Co., Ltd.	61
Falk, Stadelmann & Co., Ltd.	45	J.B.T. Electric Co., Ltd.	23
Hunch, E.	30	Vac-Tric, Ltd.	28
		White, B. S.	74

KYE, LTD., electrical importers and exporters, Brixton Road, S.W.—A winding-up order having been made against this company on March 5th, the statutory first meetings of creditors and shareholders were held on April 18th at Carey Street, before Mr. E. T. A. Phillips, Official Receiver. A draft statement of affairs was presented, showing total liabilities of £11,314 (unsecured £9,025), assets valued at £1,754, and a total deficiency of £18,577 with regard to contributories. The issued capital is returned at £11,307. The company was incorporated as a private one in August, 1923, under the name of Spencers (Electrical), Ltd., with a nominal capital of £1,000. In September, 1925, the name of the company was changed to Kye, Ltd., and the nominal capital was increased to £12,000. Accounts showed that a small net profit was made up to March 31st, 1925, but later there were net losses of £6,770 and £3,019. The failure of the company was attributed by its officials to insufficient capital; heavy advertising expenditure; loss of trade owing to defective electric lamps supplied from abroad, lamps of British manufacture not being ready soon enough to recapture the trade. A resolution was passed for Mr. E. H. Hawkins, 4, Charterhouse Square, E.C., to act as liquidator.

C. EDE & CO., LTD., radio manufacturers, High Road, Byfleet, Surrey.—A meeting of creditors was held recently, when a statement of affairs was submitted showing liabilities of £2,977, and total assets of £534, leaving a deficiency, as regarded the creditors, of £2,343. The company was incorporated in July, 1926, with a nominal capital of £100, which was issued and paid up. Further working capital was raised from time to time from some of the shareholders and their friends, and at the present time £1,430 was owing in respect of those loans. The company acquired an existing business, and the accounts up to June, 1927, showed a trading loss of £500, and since that date further losses had been incurred. The principal creditors had been asked to accept a composition of 4s. in the £, but the negotiations fell through, and a writ having been issued by one of the largest creditors, the company went into liquidation. The creditors resolved that the voluntary liquidation should be continued, subject to Mr. Bradley Hole, 240, High Holborn, W.C., being appointed joint liquidator, and a committee of inspection was also nominated.

RADIAX, LTD.—Winding up voluntarily. Liquidator, Mr. F. H. C. Christmas, 46 and 47, London Wall, E.C.

CHURCH STRETTON ELECTRIC SUPPLY CO., LTD.—A meeting of creditors is called for April 27th at 1c, King Street, St. Jams's, S.W. (This notice is purely formal, as all creditors have been or will be paid in full.)

PHONOPORE CONSTRUCTION CO., LTD.—Liquidator, Mr. T. Gourlay, Official Receiver and liquidator, 29, Russell Square, released April 12th.

Dissolution of Partnership.

RADIO EQUIPMENTS (Halifax), wireless specialists, 24, Victoria Buildings, Kihgs Cross, Halifax.—Mr. G. H. Wilson and Mr. C. France have dissolved partnership. Mr. France will attend to debts and continue the business under the same style.

British Radio Enterprise in Poland.

The decision of Marconi's Wireless Telegraph Co., Ltd., to begin the manufacture of wireless apparatus of all types in Poland is due partly to the difficulty experienced by the Marconi works at Chelmsford in coping with the flow of orders from all parts of the world, and partly to enable the company to develop trading operations in Eastern Europe. The orders received during the first three months of 1928 for execution at the Chelmsford works exceeded the orders received during the same period of 1927 by 20 per cent.

Metropolitan-Vickers Overseas Association.

The third annual dinner of this Association was held at the Grand Hotel, Manchester, on April 17th. Mr. W. A. Coates presided, and the other speakers were Sir Philip Nash, Mr. A. McKinstry, Mr. B. F. D. Docker, Mr. A. J. Shackleton, Mr. H. H. George, and Mr. Allcock, of Messrs. W. T. Glover and Co., Ltd. The London Export Company was also well represented. This Association was founded at the company's Trafford Park Works in 1925, and has at present a membership of over 250 junior and senior members of the company's staff in all parts of the world.

Book Notices.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLVII. April, 1928. New York: The Institute. Price $1.

We have received from the North Metropolitan Electric Power Supply Co. a brochure describing places of historical interest served by the company. The area covered includes Hertfordshire, a considerable portion of Middlesex, and a corner of Essex. The booklet is beautifully produced and contains some excellent photographs.

"Steam Condensing Plant." By J. Evans. Pp. xii+202; figs. 202. London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

"Broadcasts to Schools." Pp. v.+27; illustrated. London: British Broadcasting Corporation.—Programme and syllabus for the period April 30th to June 29th; as an experiment there are to be broadcasts for the younger children, about eight years old.

"The J. & P. Switchgear Book," by T. J. Barfield (140 pp., 109 figs.). Charlton: Johnson & Phillips, Ltd. Price 3s. 6d.—This useful manual deals in a very comprehensive way with many aspects of the construction and employment of switchgear. Such matters as the choice of gear, care and maintenance, tests, instrument transformers, instruments, protective gear, &c., are covered.

"*Journal* of the Institution of Electrical Engineers." Vol. LXVI. April, 1928. London: E. & F. N. Spon, Ltd. Price 10s. 6d.

Circulars of the U.S.A. Bureau of Standards.—No. 13, "United States Government Master Specification for Lamps, Electric, Incandescent, Large, Tungsten Filament" (5 cents); "Supplement to Circular No. 13" (5 cents); No. 346, "Light Metals and Alloys, Aluminium, Magnesium" ($1.10).

Local Exhibitions.

WEST LAVINGTON.—An electrical exhibition, following the recent inauguration of electricity supplies in the West Lavington, Market Lavington, and Potterne areas by the West Wilts Electric Light & Power Co., Ltd., was officially opened on April 11th by the Western Electricity Supply Co., Ltd. Mr. A. J. Bridge, general sales and commercial manager of the companies, at the opening explained the company's domestic tariff, which is based on the number of effective rooms in the consumer's house, plus a "unit" charge, and the "easy-payment" wiring scheme. Electricity is transmitted to the district by an 11,000-V overhead line linking up with the company's system at Devizes.

BUXTON.—The Mayoress (Mrs. Pugh) opened an electrical exhibition organised by the Corporation Electricity Department at the Town Hall on April 16th, and commented on the recent reduction in the price of current to 1d. per kWh for cooking, heating, and power purposes. The borough electrical engineer (Mr. Bishop) said that the exhibition held last year had resulted in an increased demand for electricity in the town.

ABERDEEN.—The recent electrical exhibition was attended with a marked degree of success. During the week about 15,400 people paid for admission. Saturday, April 14th, was the busiest day, the visitors numbering 4,000, or about double the daily average for the rest of the week.

We are informed by Mr. A. Gardner, exhibition secretary, that the local E.D.A. Circle exhibition, which closed on April 14th, was visited by over 15,500 people. He states that, in spite of the somewhat sneering reference made by one of the organs of the electrical Press to the fact that a charge was made for admission [we plead "Guilty," but not to a "sneer."—EDS., E.R.], well over 14,000 actually paid the admission charge, and this would seem sufficient justification, if any were needed, of the policy of the promoters of the exhibition.

KEIGHLEY.—The Mayor last week opened an exhibition of electrical appliances at the Municipal Hall, under the auspices of the Corporation Electricity Department. The exhibition continued for a week, and demonstrations were given in the use of all domestic electrical equipment. At an inquiry bureau information was given freely of electrical services in the home, hire-purchase facilities, &c. Local firms among the exhibitors were Messrs. G. A. Rix, J. S. Ramsbottom and Co., Ltd., Bacon & Coats, and the Smith Electrical Co., Ltd.

HALIFAX.—The Halifax Corporation Electricity Department held on April 24th and 25th, at the electricity showrooms, displays of "Jackson" electric boilers and coffee-making machines.

KING'S LYNN.—An electrical exhibition, organised by the Borough Electricity Department, was opened at the Blackfriars' Hall on Monday last by the Mayoress. It remains open until to-morrow (Saturday). In a notice of the exhibition sent us by the electrical engineer, particulars are given of the Department's favourable rateable-value tariff for domestic consumers, and the charges for the hire of cookers and kettles.

Proposed Verity Staff Association.

We are asked to announce that several former members of the staff of Messrs. Veritys, of King Street, Covent Garden, and branches, desire that a committee be formed for the purpose of forming an association composed of members, past and present, with a view to holding occasional meetings or dinners. Any old Verity member who is interested is asked to communicate with Mr. Chas. E. Davies, 159, Boyson Road, Walworth, S.E.17.

Prices of Raw Materials.

In their lead market report, dated April 21st, Messrs. James Forster & Co. state:—"Shipments from Australia during March were exceptionally heavy, amounting to 16,000 tons, so that there is every prospect next month of plenty of lead for all requirements. It remains to be seen how far present prices can be forced up before fresh arrivals of lead come on to the market. Board of Trade returns for March, 1928:—Imports, 19,510 tons; exports, 1,136 tons; leaving for home absorption, 18,374 tons."

Messrs. F. Smith & Co. and Messrs. James & Shakespeare report, April 24th: No change in copper prices.

Messrs. James and Shakespeare report, April 24th: English pig lead, £22, 10s. inc.

Messrs. Edward Till & Co. report, April 24th: No change in rubber prices.

For Sale.

Darwen Corporation Electricity Department has for disposal one 300-kW steam dynamo, with condensers, valves, &c. Mr. H. J. Shaw will sell by auction on May 3rd at 13, High Holborn, W.C., various stocks of wireless and electrical goods. Salford Corporation Electricity Department invites offers for 2,000 electric lamps (50 to 200 V), which have been replaced by higher-voltage lamps. Mr. A. P. Gilmour, the liquidator of Ross & Co. (Electric), Ltd., invites offers for the business of electrical manufacturers and wholesale suppliers, situate at 41-43, Robertson Street, Glasgow. Messrs. Fuller, Horsey, Sons & Cassell will sell by auction, on May 3rd, at Vickers, Armstrong, Ltd., Machinery Depôt, Erith, engineers' machine tools, electric motors, &c. South Shields Corporation Electricity Department has for disposal surplus generating plant, feed pumps, &c. (See our advertisement pages to-day.)

Lighting and Power Notes.

Argentina.—BUENOS AIRES.—The Compania Italo-Argentina de Electricidad has been granted permission to erect a large super-power station in the vicinity of the new port works at Buenos Aires, the cost of which is estimated at 50,000,000 paper pesos. The company, which at present generates more than 108,000,000 kWh per annum, has been allotted an area of 90,000 square metres for the new station, which will have an ultimate capacity of 300,000 kW, divided into three sections of 100,000 kW each.—*Reuter's Trade Service* (Buenos Aires).

Australia.—YALLOURN (VIC.).—According to the *Industrial Australian and Mining Standard*, within the next two years extensions of the generating plant at Yallourn (Vic.) will be necessary to meet the expected increased demand for electricity over the area supplied from that centre. The State Electricity Commission has indicated that the position could best be met by the erection of another power house at Yal-

lourn. The American expert who reported on the State electricity undertaking (Mr. W. H. Sawyer) strongly recommended that the possibility of erecting new power houses near Melbourne should be investigated before extensions at Yallourn were considered. That report had been examined by the Electricity Commission, but, despite Mr. Sawyer's recommendations, it is of the opinion that another power house should be built at Yallourn. It is understood that definite recommendations will shortly be made by the Commission. The existing transmission line, which was constructed for a capacity of 50,000 kW, is already being overloaded by about 20 per cent. If another power house is erected at Yallourn, another transmission line will have to be erected to Melbourne, and in constructing this line it will be possible to make provision for relieving the excessive overloading of the present line. Moreover, the open-cut at Yallourn, and much of the plant, will be available for the new power house, and a saving will be effected, because overhead charges now being carried by the Yallourn power house will be divided with the new power house.

Barnsley.—New Plant.—The Corporation Electricity Committee has recommended that application be made for sanction to install one 25,000-lb. water-tube boiler, together with an induced-draught fan and chimney, at an estimated cost of £6,750, in order to meet next winter's load.

Bedford.—Loans Sanctioned.—The Corporation Electricity Committee has received sanction to the following loans: Mains extensions, £26,460; plant (sub-station equipment and kiosks), £4,070.

Buxton.—New Plant.—The Town Council has decided to carry out extensions to the power station, including the installation of a Premier oil engine, at an estimated cost of £11,500.

Canada.—St. Lawrence Development.—The correspondence exchanged between the Canadian and United States Governments in respect of the proposed St. Lawrence power and navigation development scheme was laid on the table of the House of Commons on April 16th. Both Governments agree that a basis of negotiations has been reached for proceeding to carry out a scheme involving a 27-ft. waterway to the head of the Great Lakes, the development of approximately 3,000,000 h.p., and an expenditure of approximately $650,000,000. The main proposals are that Canada should construct and control the wholly Canadian section of the St. Lawrence shipway, including the new Welland Canal, at a total expenditure of approximately $315,000,000, and the development of approximately 1,000,000 h.p., this power development to be exclusively for Canadian use, while the United States should construct the international section of the St. Lawrence River and complete the Upper Lake channels to a depth of 27 ft., at a total estimated cost of $339,000,000. The power development of the international section, it is estimated, would be 1,602,000 h.p., to be shared equally by Canada and the United States.—*Reuter* (Ottawa).

Continental.—Holland.—The Hague correspondent of the *Times Trade and Engineering Supplement* reports that the Town Council of Rotterdam has passed a resolution approving the extension of the electricity works at a total cost of 16,000,000,000 Dutch guilders, of which about one-third is for buildings and two-thirds for machinery and accessories. The existing power station has a capacity of 59,000 kW, and the new extension is planned for 150 000 kW, divided into six sets, but it is not intended to install these at once. The first stage will be the purchase and installation of a 30,000-kW set, which will suffice for the next five or six years. As the director of the electricity works is now in the United States studying the results of heating with powdered fuel, it seems probable that such a system will be adopted. The order is expected to be placed in June, and completion will be asked for by the end of 1929 or the beginning of 1930.

Belgium.—In order to meet the increasing demand for electricity at the various pleasure resorts along the Belgian coast, the Société de l'Electricité du Littoral has recently placed a contract for a new 6,000-kW steam turbo-generator for the power station at Slykens, which will increase the capacity to 20,000 kW. An interconnecting 36,000-V transmission line has been erected between the Slykens station and those at Langerbrugge and Zeebrugge.

Italy.—Work is steadily proceeding on the construction of the Ponale hydro-electric plant situated near Riva, at the northern end of Lake Garda. The plant will be one of the largest in Italy. It is furnished with a fall of over 1,900 ft., at an angle of 45 deg., and has a maximum productive capacity of 100,000 h.p. The intake of the water is near the village of Mezzolago, 70 ft. below the level of the Lake of Leydro. From this point a tunnel 3¾ miles long, bored through the rock of Monte Oro, leads to Lake Garda. The power developed will be transmitted by h.p. line to Verona, Mantua, Modena, and Bologna.

Coventry.—Loan.—The Electricity Committee has recommended that application be made for sanction to a loan of £115,154 for trunk mains in connection with the Longford generating station.

Crediton.—Scheme Approved.—At a recent meeting of the Rural District Council approval was given to the West of England Electricity Company's scheme, which will include many of the parishes in the district.

Cupar (Fife).—Electricity Supply.—It was stated at the last meeting of the Town Council that the Fife Electric Power Co. would probably be in a position to supply electricity within twelve months, and that a large number of shopkeepers had agreed to take supplies.

Finchley.—Electricity Supply.—At a recent meeting of the Urban District Council Electricity Committee the electrical engineer reported upon an interview with the Central Electricity Board, and stated that he had been given a tentative price at which a bulk supply would be afforded to the Council. The Committee decided that the proposal was not satisfactory, and the clerk submitted a draft of a communication to the Electricity Commissioners, requesting them forthwith to deal with the Council's application for sanction to the loan of £24,000 in respect of the installation of a 3,000-kW set, for which application was made in June, 1926.

Hull.—Supply to Housing Estate.—At a recent meeting of the Corporation Housing Committee the town clerk reported that the Electricity Committee had decided that upon the Housing Committee serving the necessary notices to terminate the existing fixed-price system of electricity charges, the Electricity Committee would be prepared to substitute prepayment meters, such system to apply to any additional houses. The Committee would also lay underground cables in the new portion of the estate, and provide meters for the whole estate, at an estimated cost of £11,749.

London.—St. Pancras.—The Borough Council has received a communication from the Electricity Commissioners stating that they are prepared to favourably consider an application for the installation of larger plant than that already applied for. The Electricity and Public Lighting Committee has therefore recommended that one 15,000-kW set be installed at an estimated cost of £53,550 in substitution of the 10,000-kW set originally contemplated, at an estimated cost of £42,500.

Islington.—The Borough Council Electricity Committee has obtained sanction to the borrowing of £15,500 for the erection of additional cooling towers at the electricity works.

Manchester.—Progress during February.—During the month of February the Corporation electricity undertaking showed an increase in connections of 1,766 kW, bringing the total up to 340,421 kW; and the number of applications received for supply, including consumers for additional supplies, was 1,006, representing a total of 2,395 kW. The number of hired cookers connected increased by 76, bringing the total actually on circuit to 4,213. Applications for the hire of cookers totalled 103. A new sub-station was put into commission at Denton (West), the plant including two 3,000-kVA and two 250-kVA transformers.

Oxford.—Appointment of Consultant.—The City Council has appointed Mr. J. H. Rider as consulting electrical engineer, at a retaining fee of 100 guineas per annum.

Perthshire.—Electricity Supply.—It is reported that the Scottish Power Co., Ltd., which controls the Grampian Electricity Supply Co., is to take immediate steps to introduce electric lighting to North Perthshire. The scheme provides for the erection of cable from Kinloch Rannoch, by Strath-Tummel and Kirkmichael, thence to Alyth, Kirriemuir and Arbroath. It is the intention of the company to take a temporary supply from Arbroath to Kinloch Rannoch, until such time as the new power stations in connection with the Loch Ericht-Loch Rannoch works are erected at Ardlarich, near Bridge of Ericht, and at Tummelbridge, and it is hoped that a start will be made with the additional scheme this summer.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

Holmfirth (Yorks.).—Lighting (shops): From 6½d. to 6d. per kWh. Domestic purposes: From 1½d. to 1d. per kWh.

Whitehaven.—Lighting: From 5½d. to 5¼d. per kWh. Maximum demand system: From 2½d. to 2¼d. per kWh. Power for kinemas: From 2¾d. per kWh to a fixed charge of £4 per quarter, plus 2d. per kWh.

Richmond (Yorks.). — Loan Sanctioned. — The Town Council has received sanction to a loan of £4,706 for mains.

Sealand (Cheshire).—Electricity Supply.—The aerodrome power station is to be dismantled, and arrangements are being made for an electricity supply from the North Wales Power Co., which has already commenced the laying of mains.

Special Orders.—Application has been made to the Electricity Commissioners for a Special Order by the Urban District Councils of Altrincham, Ashton-upon-Mersey, Bowdon, and Hale, and the Rural District Council of Bucklow to constitute a Joint Board for the purpose of the joint exercise of all powers under the Electricity (Supply) Acts, and to supply electricity in the urban districts and parts of the rural district.

The Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them to be granted to the Gwynedd Trust, Ltd., for the supply by the Electricity Distribution of North Wales and District, Ltd., of electricity in the rural districts of Glaslyn and Deudraeth.

Taunton.—Loans.—The Town Council has applied for sanction to the following loans: Mains and services, £12,500; meters, £1,500; transformers and transformer chambers,

£1,500; cookers, £1,000; extension of d.c. and a.c. main switchboards, £700.

Tynemouth.—ASSISTED WIRING SCHEME.—At a recent meeting of the Corporation Electricity Committee, the electrical engineer reported that there was still a very great opening for assisted wiring, and he recommended that application should be made for sanction to borrow £10,000 for approximately 1,200 installations. The recommendation was adopted.

United States.—ELECTRICAL DEVELOPMENT.—According to the *Electrical World*, the Duke Power Company has commenced construction work on the first unit of its steam plant at Riverbend, on the Catawba River, 12 miles from Charlotte. The generating equipment to be used in the first unit will include two 56,000-kW turbo-generators served by four boilers. A possible eventual installation of 450,000 kW in this plant is announced.

Tramway and Railway Notes.

Birmingham.—NEW CARS.—The Tramways Committee has decided to purchase 30 additional tramcars and 40 additional omnibuses.

Continental.—SPAIN.—Work is approaching completion on the construction of a tramway, five miles in length, between Madrid and Cuatro-Vientos.

Leeds.—YEAR'S WORKING.—For the year ended March 31st last the total receipts of the Corporation tramway and transport undertaking were £1,003,547, an increase of £79,228 on the previous year. The tramway increase was £52,830, and the motor-'buses £27,730. There was a decrease of £1,332 on the railless-car service, and this is being replaced by motor-'buses. The total number of passengers carried exceeded 160 millions, an increase of over 13 millions.

L.M.S. Railway.—NEW TYPE OF TRAIN.—A trial run has been given on the L.M.S. Railway between Manchester and Blackpool of a new type of train, the first of its kind to be seen in this country, consisting of four coaches. The power unit in the first part of one of the end coaches is a 2,500-h.p. Beardmore Diesel engine, driving generators for supplying power to the traction motors. The engine, run on crude oil, has a speed of from 50 to 55 miles an hour. It is claimed the system is more economical than steam, and it is suitable for suburban traffic. Control is from either end, and one man can drive it. If the driver releases the controlling handle the power is automatically cut off, and the brakes, of the standard vacuum type, and applied. The electrical equipment has been constructed by the English Electric Co.

Manchester.—TRANSPORT SCHEME.—*The Times* reports that another scheme to solve the traffic problem was brought before the City Tramway Committee on April 17th, when Mr. H. Mattinson, the general manager, submitted a proposal to connect the three railway stations at London Road, Victoria, and Central by electric railways, and to construct central stations at Piccadilly and Albert Square. By this means passengers would be able to join a train at Piccadilly or Albert Square and travel direct to any of the stations on the main line. The object is to relieve congestion in the central area, but there is no reason, if the scheme is carried through and proves successful, why underground stations should not be provided in other parts of the city. The Tramways Committee decided that the scheme was of such magnitude that it should be sent to the Underground Railways Committee and the Traffic Congestion Committee of the Corporation so as to permit of a joint conference on this and the other schemes which are under contemplation. It is understood that the co-operation of the railway companies will be sought, and that the Corporation will pay the cost of the electric railway. It is estimated that the cost of Mr. Mattinson's scheme will be less than the underground tube scheme for the whole of the city, which, it was stated, would cost £250,000 per mile.

United States.—RAILWAY ELECTRIFICATION.—The *Electrical World* reports that the Pennsylvania Railroad has almost completed the overhead installation from Wilmington, Del., to Philadelphia. A voltage of 11,000 will be used at first on this section of the railroad, and power will be purchased from the Philadelphia Electric Company for both this section and that from Philadelphia to West Chester. The Pennsylvania Company has authorised further electrification which will be made in successive steps. These include the main line from Philadelphia to Newark and the line from Philadelphia to Pittsburgh. Newark will replace Manhattan Transfer as the station where a change to the downtown New York tubes can be made. Power will be purchased by the company from adjacent utilities, and a large generating station is being designed by the Public Service Company of New Jersey to afford the required energy in its territory as well as to care for system load growth.

The New York Central & Hudson River Railroad has made an analysis of the economies and service advantages of electrification from New York to Albany and thence to Buffalo, and a favourable decision is expected in the near future. The extended utility systems make possible an adequate power supply in these regions, and the use of the high-voltage overhead system, combined with purchased energy, reduces the railroad investments very materially. In the next few months a very large electrification programme for these Eastern railroads is likely to be adopted.

Telegraph and Telephone Notes.

Corea.—SUBMARINE TELEPHONE CABLE.—The acting British Consul-General at Seoul informs the Department of Overseas Trade, in connection with the scheme to connect Corea and Japan by submarine telephone, that the section from Fukuoka to Idzuhara (in Japan) was incorporated in the Budget of 1927, and the work will be carried out shortly. The section from Idzuhara to Fusan (in Corea) is included in the Budget for 1928. The cable will be purchased abroad, and immediately on its arrival the work will be put in hand, Yen 700,000 being allotted for this purpose. It is expected that the line will be completed by October this year.

Germany.—WIRELESS IN OCCUPIED TERRITORY.—Steamboats passing up and down the River Rhine, either for commerce or pleasure, have hitherto been precluded from the use of wireless while passing through Occupied Territory. This prohibition has now been partially removed, and permission to own and operate receiving sets has been accorded; owners must, of course, comply with the German Government regulations governing the use of wireless apparatus.—*Reuter* (Coblenz).

International Telephony.—BELGIUM-IRELAND SERVICE.—Telephone communication was inaugurated between Brussels (Belgium) and Dublin (Irish Free State) on April 17th. Speech was good throughout.—*Reuter* (Brussels).

The Telegraph Service.—PHOTOTELEGRAPHY.—It is understood that experiments are being carried out by the engineering department of the General Post Office to ascertain the possibilities of the transmission of telegram facsimiles.

Radio Notes.

Australia.—NEW SHORT-WAVE STATION.—The Melbourne station (3LO) has been granted a special licence to conduct a world broadcast on May 6th on a wave-length of 32 metres; the programme will start at 9.45 a.m., Melbourne time, and continue at intervals until 5.45 p.m. In view of the success of recent world broadcasts, Amalagamated Wireless of Australasia, Ltd., has decided to provide a new powerful short-wave broadcasting station, probably at Sydney, to continue the service.—*Reuter* (*Melbourne*).

Battery Eliminators.—BANGOR CORPORATION'S RESTRICTIONS.—In view of the fact that in some districts where the distribution of electricity is being converted from d.c. to a.c. the electricity undertaking is replacing parts of its consumers' wireless apparatus in the same manner as other domestic appliances are changed, it is interesting to record that Mr. Price White, electrical engineer to the Bangor Corporation, has reported to the City Council that several electricity consumers are using h.t. eliminators in connection with their wireless receivers, connected to their domestic electricity mains. The Corporation's electricity regulations prescribe that no apparatus shall be connected to a consumer's installation before notifying the electrical engineer so that the apparatus proposed may be inspected and tested when thought necessary. Cases might arise of consumers proposing to use apparatus which the Corporation considered should not be connected to its system. The Corporation's statutory right to decline to connect certain apparatus was without question. "Certain types of wireless h.t. eliminators," proceeded Mr. White, "are such that for technical reasons their connection to the Corporation's mains is undesirable, and in view of the fact that the Council has approved of a scheme which will result in the distributing system being changed from direct to alternating current, approval of the use of wireless h.t. eliminators at present is not desirable, as it may involve heavy expenditure by the Corporation in substituting an a.c. type for the d.c. type when the change-over does takes place." The Council decided not to approve of the connection of h.t. eliminators to electricity consumers' installations unless they conform to the electrical engineer's requirements in certain technical matters, and unless the consumer using them gives a written undertaking that the Corporation will not be called upon to change d.c. types for a.c. types when the system is changed over.

"Beam" Radio-telegraphy.—CANADA-AUSTRALIA SERVICE.—The Canadian Marconi Company announces that the Canada-Australian "beam" service is expected to be opened shortly for commercial working. The report that the preliminary tests have revealed unexpected difficulties and that "the contractors have found it impossible to submit the station for official test" is said by the company to be without foundation.

Germany. — SCHOOL BROADCASTING. — The long planned scheme for utilising the broadcast radio-telephone service for school instruction was to commence on April 25th. The prime mover is the Prussian Minister for Arts and Science, who has made the necessary arrangements with the West German Radio Company.—*Reuter* (Cologne).

Hungary.—SUBSCRIBERS.—In a recent note it was stated that the number of radio subscribers in Hungary was 800,000. The Budapest representatives of the International Standard Electric Corporation inform us that the correct figure is 80,000.

School Broadcasting.—EXTENSION.—The British Broadcasting Corporation announces that school broadcasting has expanded rapidly of late: some 5,000 schools are known to use receiving sets, but the actual number may be considerably greater. Last term 100,000 school "Aids to Study" pamphlets were applied for, which figure probably corresponds roughly to the actual number of pupils in the "wireless school."

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Acton.—April 30th. Town Council. Switchboard for the Public Baths. (April 13th.)

Argentine.—BUENOS AIRES.—June 8th. Department of Sanitary Works for the Nation. Two groups of electric sewage pumps for the Military College and Aviation Camp. (A. 6186.)*

Australia.—MELBOURNE.—May 9th. Victorian Railways. 100 2,200-V oil switches. (B.X. 4343.)* Circuit controllers for point lay-outs. (B.X. 4344.)*

September 3rd. State Electricity Commission of Victoria. 120,000-V switchgear for Richmond terminal station; 135,000-V switchgear for Yallourn power station extension. (April 20th.)

May 8th. Postmaster-General's Department. Telephone cable. (B.X. 4358.)*

June 12th. Resistances and reactances. (B.X. 4359.)*

May 2nd. 26 pair 20-lb. telephone cable. (B.X. 4380.)*

SYDNEY.—August, 1928. N.S.W. Government Railways. Two 20,000-kW turbo-alternators and condensing plant for Ultimo power house. Spec. No 816 (price 15s.), from Chief Electrical Engineer, 61, Hunter Street, Sydney.

Barking.—May 15th. County of London Electric Supply Co., Ltd. Installation of electric lighting at the Barking power station extensions. (April 13th.)

Birmingham.—May 16th. Birmingham Tame and Rea District Drainage Board. 5½ miles e.h.p. cable. (See this sisue.)

Blackburn.—May 7th. Electricity Department. Two duplex natural draught cooling towers, each 500,000 gallons per hour capacity. (April 20th.)

Bulgaria.—TROYON.—May 30th. Water Syndicate. Pipe lines, water turbines, generators, switchgear and accessories. (B.X. 4378.)*

Colombia.—BOGOTA.—June 15th. Ministry of Posts and Telegraphs. 5,750 km. of telegraph line. (B.X. 4334.)*

Denmark.—COPENHAGEN.—May 5th. Lighting Department. Electric cables and wire for 12 months. (B.X. 4379.)*

Dublin.—May 1st. Port and Docks Board. One 20-kW motor-generator set and control gear. Specifications from Engineer to the Board, East Wall, Dublin.

Edinburgh.—May 7th. Electricity Department. Plant for the Portobello generating station. Four steam generating units, &c., evaporation 65/80,000 lb. per hour. Eight mechanical stokers, with driving gear, suspended arches, ash hoppers, &c. Specification, &c., from Mr. Edwin Seddon, engineer and manager (deposit of £2 2s.).

Egypt.—CAIRO.—June 16th. Ministry of the Interior. One 300-h.p. Diesel engine, direct coupled to a 250-kVA alternator, for the Damanhour power station extension. (B.X. 4349.)*

Grimsby.—May 1st. Electricity Department. Boiler plant. (April 13th.)

Harrogate.—April 28th. Electricity Department. E.h.p., h.p., and l.p. switchgear, transformers, service meters, and service cut-outs. (April 13th.)

India.—May 8th. India Stores Department. 4,000 lb. silk-covered copper wire. (April 20th.)

Leeds.—April 30th. Board of Guardians. Supply and laying underground l.p. cables at St. James' Hospital, Beckett Street. Mr. J. J. E. Storr, consulting engineer, 14, Park Row, Leeds (deposit £1).

May 4th. Supply of electric lamps. Mr. James H. Ford, clerk to the Guardians, 11, South Parade, Leeds.

May 9th. City Property Committee. Installation of electrical switchgear at the Cookridge Street baths, Leeds. Mr. W. T. Lancashire, city engineer, Municipal Buildings.

London.—ST. PANCRAS.—May 11th. Electricity Department. Two 1,000-kW and three 2,500-kW motor convertors. (April 20th.)

ST. MARYLEBONE.—May 2nd. Electricity Department. 12 months' supplies of l.p. and e.h.p. underground cables. (April 20th.)

METROPOLITAN ASYLUMS BOARD.—May 9th. Extension to the electric lighting installation at the South-Eastern Ambulance Station, New Cross Road, S.E. (See this issue.)

Manchester.—May 2nd. Electricity Committee. Twelve months' supply of meters, cable, electric kettles, and potential and current transformers. (April 13th.)

May 1st. Eight 250-kVA static transformers. (April 20th.)

May 16th. 33,000-V and 6,600-V switchgear, also switch-operating batteries and charging gear. (See this issue.)

Oban.—May 5th. Town Council. Electric lighting of seven blocks of houses. Specifications from Mr. D. Galloway, burgh surveyor.

Perth.—May 7th. Electricity Department. L.p. feeder and pilot cables. (See this issue.)

Ripon.—May 19th. Electricity Department. E.h.p. and l.p. cables, boxes, roadwork and public lighting. (April 20th.)

Southampton.—May 29th. Electricity Committee. One 15,000-kW turbo-alternator set, with condensing plant, 2,000-kW rotary-converter set, with transformer, starting panel, e.h.p switch cubicles, control panels, and boiler feed, &c. (See this issue.)

South Africa.—PRETORIA.—May 31st. Department of Posts and Telegraphs. Outdoor distribution boxes for 15-pair telephone cable and magneto and central battery switchboards. (B.X 4324.)*

June 7th. Telephone cable, copper wire, &c. (B.X. 4335.)*

CAPE TOWN.—May 2nd. Municipal Council. 1,000 wrought-iron or mild steel tubular electric light poles. (A.X. 6157.)*

JOHANNESBURG.—May 25th. Municipal Council. 6,600- and 3,300-V switchgear, with cables, signalling and telephone apparatus, and power and lighting transformers. (B.X. 4371.)*

Southend-on-Sea.—May 1st. Light Railways and Electricity Department. 1,500 current limiters. (April 13th.)

Stone.—May 8th. Urban District Council. E.h.p. overhead electric transmission line, &c. (April 20th.)

Swindon.—May 5th. Electricity Department. H.p. feeder, l.p. pilot and other cables. (April 13th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Aberdeen.—Parish Council.
Rewiring Council Chambers.—Bell & Robertson.

Bedford.—Electricity Committee. Recommended:—
Construction of overhead main to Apsley Guise and Apsley Heath (£2,849).—Robert M. Russell (Glasgow).
Supply of cable for one year (schedule prices).—Siemens Bros. & Co., Ltd.
Main switchgear (£2,445).—British Thomson-Houston Co., Ltd.
12,500-kW turbo-alternator, with condensing plant by W. H. Allen, Sons & Co., Ltd. (£36,474).—C. A. Parsons & Co., Ltd.
One 40,000-lb. boiler (£11,250).—Stirling Boiler Co., Ltd.
30-ton crane (£1,065), trolley wire (£185).—Bedford Engineering Co.

Bournemouth.—Pavilion Committee. Accepted:—
Installation of synchronous clocks at new pavilion (£108).—Synchronome Co., Ltd.

Erith.—Urban Council. Accepted:—
Cable for 12 months (£4,997).—Callender's Cable and Construction Co., Ltd.

Finchley.—Electricity Committee. Accepted:—
Turbo-alternator and accessories (£13,500).—Brush Electrical Engineering Co., Ltd.
Boiler (£10,450).—Clarke, Chapman & Co., Ltd.

Glasgow.—
Electrical work at new technical school, Roman Catholic school, &c., Bathgate.—Fraser & Borthwick.

Government Contracts.—The following contracts were placed by various Government Departments during March, 1928:—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

Motor alternators.—W. Mackie & Co., Ltd.; Newton Bros. (Derby), Ltd.
Ammeters.—Johnson & Phillips, Ltd.
W./t. boards.—Whipp & Bourne, Ltd.; General Electric Co., Ltd.
Distribution boxes, &c.—Express Lift Co., Ltd.; Chadburns (Ship) Telegraph Co., Ltd.; L. Weeks (Luton), Ltd.; Engineering and Lighting Equipment Co., Ltd.; Player & Mitchell; General Electric Co., Ltd.; Edison Swan Electric Co., Ltd.; Whipp & Bourne, Ltd.
Oil circuit-breaker apparatus.—British Thomson-Houston Co., Ltd.
W./t. coils.—Radio Instruments Ltd.; H. W. Sullivan, Ltd.; Gambrell Bros.
Electrically-driven compressors.—Reavell & Co., Ltd.
Condensers.—Dubilier Condenser Co. (1925), Ltd.
Electric hot cupboards.—Benham & Sons, Ltd.
Electric heating equipment.—General Electric Co., Ltd.
Battery gear.—Premier Accumulator Co., Ltd.
Motor-generator sets.—Newtons of Taunton.
Motor generators.—Newton Bros. (Derby), Ltd.; Bull Motors.
Telemotor-operated hoists. — Vickers-Armstrong, Ltd.; McTaggart, Scott & Co., Ltd.
Electric lighting installation.—G. E. Taylor & Co.
Electric lamps.—Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.; Siemens Electric Lamps and Supplies, Ltd.
Telephone leads.—Ward & Goldstone, Ltd.
W./t. panels.—H. W. Sullivan, Ltd.; The Plessey Co., Ltd.
Electric lighting plant.—Mann, Egerton & Co., Ltd.
Regulators and starters.—Small Electric Motors, Ltd.; E. N. Bray, Ltd.; Whipp & Bourne, Ltd.
Automatic starters, resistances and switches.—Watford Electric & Mfg. Co., Ltd.
Switches, sockets and plugs.—Edison Swan Electric Co., Ltd.
Transformers.—English Electric Co., Ltd.; Ferranti, Ltd.
W./t. valves.—General Electric Co., Ltd.
Electrically-driven winches.—Napier Bros., Ltd.; Harfield and Co., Ltd.
Enamelled copper wire.—British Insulated Cables, Ltd.; London Electric Wire Co. & Smiths, Ltd.
Fittings for w./t. apparatus.—G. H. Williams & Co.; G. A. Harvey & Co. (London), Ltd.; Ross, Courtney and Co., Ltd.

WAR OFFICE.

Cables and accessories.—Macintosh Cable Co., Ltd.
Generating sets.—Douglas Motors, Ltd.
Automatic generator plant.—Davey, Paxman & Co., Ltd.
Rotary transformers.—Newton Bros. (Derby), Ltd.
W./t. valves.—General Electric Co., Ltd.; Edison Swan Electric Co., Ltd.
Wireless telegraph sets.—Dubilier Condenser (1925), Ltd.

AIR MINISTRY.

Accumulators.—Peto & Radford.
Underground electric cables.—(Duxford): T. Clarke and Co., Ltd.; (Hucknall): Cox, Walker & Partners.
Resistance and voltmeter control.—British Radio Corporation, Ltd.
Magnetos.—Simms Motor Units, Ltd.
Petrol-electric cranes.—Ransomes & Rapier, Ltd.

POST OFFICE.

Telephone apparatus.—Automatic Telephone Mfg. Co., Ltd.; Ericsson Telephones, Ltd.; Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Standard Telephones & Cables, Ltd.; Sterling Telephone & Electric Co., Ltd.
Testing, protective and miscellaneous apparatus.—British Thomson-Houston Co., Ltd.; Hackbridge Electric Construction Co., Ltd.; Standard Telephones & Cables, Ltd.; Telegraph Condenser Co., Ltd.
Cable.—British Insulated Cables, Ltd.; Callender's Cable and Construction Co., Ltd.; Connollys (Blackley), Ltd.; Enfield Cable Works, Ltd.; W. T. Glover and Co., Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Pirelli-General Cable Works, Ltd.; Standard Telephones & Cables, Ltd.; Union Cable Co., Ltd.
Joint-box castings.—Grahamston Iron Co., Ltd.; United Steel Cos., Ltd. (Thos. Butlin & Co.).
Dry cells.—Fuller Accumulator Co. (1926), Ltd.; General Electric Co., Ltd.
Cords for telephones.—British Insulated Cables, Ltd.; International Electric Co., Ltd.; Reliance Electric Wire Co.; Siemens Bros. & Co., Ltd.; Standard Telephones & Cables, Ltd.
Ducts.—J. Place & Sons.
Telegraph ironwork.—Bullers, Ltd.
Lamps.—A. C. Cossor, Ltd.
Enamelled copper wire.—Concordia Electric Wire Co., Ltd.
H.d. copper wire.—Edison Swan Cables, Ltd.; E. and E. Kaye, Ltd.; Nevill, Druce & Co., Ltd.; Whitecross Co., Ltd.
Service boxes.—Venner Time Switches, Ltd.
Manufacture, supply, drawing-in and jointing cable.—Beckenham-Addiscombe Junction: Callender's Cable and Construction Co., Ltd.
Lift.—East Croydon S.O.: Keighley Electrical Engineering Co., Ltd.
Power plant.—Leafield radio station: Crompton-Parkinson, Ltd.
Telephone exchange equipment.—Amherst: Automatic Telephone Mfg. Co., Ltd. Sub-contractors: Newton Bros. (Derby), Ltd., for machines; Alton Battery Co., Ltd., for batteries. Funam and Bridlington: Standard Telephones & Cables, Ltd. Sub-contractors: Crompton-Parkinson, Ltd., for machines; Chloride Electrical Storage Co., Ltd., for batteries. Purley: Standard Telephones & Cables, Ltd. Moss Side (Manchester): General Electric Co., Ltd. Sub-contractors: D.P. Battery Co., Ltd., for batteries. Southbourne (Bournemouth): General Electric Co., Ltd. Sub-contractors: Crompton-Parkinson, Ltd., for ringing machines; Chloride Electrical Storage Co., Ltd., for batteries. Dudley and Stourbridge (Dudley multi-exchange area): Siemens Bros. & Co., Ltd. Sub-contractors: English Electric Co., Ltd., for charging machines; Crompton-Parkinson, Ltd., for ringing machines; Chloride Electrical Storage Co., Ltd., for batteries. Brierley Hill (Dudley multi-exchange area) contractors: English Electric Co., Ltd., for charging contractors English Electric Co., Ltd., for charging machines; W. Jones & Co., for ringing machines; Chloride Electrical Storage Co., Ltd., for batteries. Fleetwood and Manchester Corporation: Relay Automatic Telephone Co., Ltd.
Voice-frequency telegraph apparatus (London repeater station, G.P.O., South, and Leeds).—General Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Cables.—Hooper's Telegraph and India Rubber Works, Ltd.; Siemens Bros. & Co., Ltd.
Copper conductors.—R. Johnson & Nephew, Ltd.
Electrical equipment.—J. Stone & Co., Ltd.
Generating set.—Ruston & Hornsby, Ltd.
Phantophones.—Automatic Telephone Mfg. Co., Ltd.
Static transformers.—Brush Electrical Engineering Co., Ltd.
Switchgear.—Electric Control, Ltd.
Telegraph line materials.—J. Spencer, Ltd.
Telephone materials.—Ericsson Telephones, Ltd.
Train-control apparatus.—Standard Telephones & Cables, Ltd.

Irish Free State.—DUBLIN.—Department of Posts and Telegraphs.

Brass strip.—Wilbraham & Smith.
Cable.—Deutsche Telephonwerke & Kabelindustrie; Standard Telephones & Cables, Ltd.; W. F. Dennis and Co.; Victor Zorn; Siemens Schuckert (Ireland), Ltd.
Porous cells.—Siemens Schuckert (Ireland), Ltd.; Siemens Bros. & Co., Ltd.
Instrument parts (telephone).—Phœnix Telephone and Electric Works, Ltd.
Radio power valves.—Standard Telephones & Cables, Ltd.
Bridle wire.—Standard Telephones & Cables, Ltd.
—*Irish Electrician.*

Leicester.—Electricity Committee. Accepted:—
Extensions at the Central Generating Station (£413,535).—International Combustion, Ltd.

London.—ST. PANCRAS.—Contract and Stores Committee.
6,660-V, paper-insulated, lead-covered and armoured cable:—

SIEMENS BROS & CO., LTD. (Recommended)	£2,652
Hackbridge Cable Co., Ltd.	2,667
Pirelli-General Cable Works, Ltd.	2,705
Standard Telephones & Cables, Ltd.	2,721
British Insulated Cables, Ltd	2,743

Wiring and fitting eight flats, Drummond Crescent (£67).—P. J. Driscoll, Ltd. (Recommended.)
Storage battery for dust van (£182).—Chloride Electrical Storage Co., Ltd. (Accepted.)
HACKNEY.—Works Committee. Accepted:—
Battery for electric vehicle (£217).—Chloride Electrical Storage Co., Ltd.

London United Tramways, Ltd.—Accepted:—
102 50-h.p. light tramway motors.—General Electric Co., Ltd.

London. — Islington. — Electricity Committee. Recommended:—
Repairing blading of turbine (£550).—Richardsons, Westgarth & Co., Ltd.

Manchester.—Tramways Committee.
30 50-h.p. tramway motors.—General Electric Co., Ltd.

Oakham.—Accepted:—
Complete electric lighting installation with generating sets and storage batteries at Exton Hall.—Mr. Cyril F. Williams (Farnham, Surrey).

Paignton.—Beach Committee. Accepted:—
Installation of electric lights at shelters on the front (£5 per shelter).—Paignton Electric Light and Power Co., Ltd.

Rugby.—Electricity Committee. Accepted:—
Nine 30-kVA transformers (£308) and 12 50-kVA ditto (£579).—English Electric Co., Ltd.

South Africa.—Cape Town.—Electricity Committee. Accepted:—
500 fuse carriers (£197); 1,000 cross arms (£162).—General Engineering Co., Ltd.; 2,000 cross arms (£201).—Albert Vaux, Ltd.

Swansea.—Education Committee. Accepted:—
Electric lighting installation, Llansamlet school (£255).—C. Jones (Pontardawe).

Tynemouth.—Electricity Committee. Accepted:—
Cable.—Macintosh Cable Co., Ltd.

Forthcoming Events.

Physical Society.—Friday, April 27th. Imperial College of Science, South Kensington. 5 p.m. Ordinary meeting.

Birmingham Electric Club.—Friday, April 27th. Grand Hotel. 7 p.m. "Modern Developments of Magnetting Machinery." Mr. W. Box.

Royal Institution of Great Britain.—Friday, April 27th. 21, Albemarle Street, W.1. 9 p.m. "Carriers of Electricity in the Atmosphere." Mr. A. M. Tyndall.

Royal Society of Arts.—Wednesday, May 2nd. John Street, Adelphi, W.C. 8 p.m. "Standardisation in Apparatus for Science Teaching," by Mr. W. Taylor.

Institution of Electrical Engineers.—Thursday, May 3rd. Institution, London, W.C. 6 p.m. "Practice and Progress in Combustion of Coal as Applied to Steam Generation." Mr. F. H. Rosencrants.

(Wireless Section).—Wednesday, May 2nd. Institution, London, W.C. 6 p.m. "Screened-grid Valves." Mr. M. G. Scroggie.

(Scottish Centre).—Friday, April 27th. Foresters Hall, Dundee. 7.30 p.m. Faraday lecture. "Electricity in the Service of Man." Dr. S. Z. de Ferranti, F.R.S.

(London Students' Section).—Friday, April 27th. Institution, London, W.C. 6.15 p.m. Annual general meeting. "Super Tension." Mr. R. A. Brockbank.

Junior Institution of Engineers.—Friday, May 4th. 39, Victoria Street, S.W. 7.30 p.m. "The Application of Electricity to Domestic Purposes." Mr. F. C. Dain.

The "Electrical Review" Service Department.

Inquiries must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

Klidos plugs and sockets for use on ships.
Durham Duplex and
Elektrostar vacuum cleaners.
Flag brand staples.
British Domestic electric iron.

Notes.

I.E.E. Scottish Centre Golf Competition.

The annual golf competition in aid of the Benevolent Fund of the Institution, for which purpose a very handsome silver challenge cup, named "The Scottish Centre Benevolent Cup," has been presented by Messrs. W. L. Winning and Andrew Hutcheson, will be open to members of all classes, and it is hoped that as many as possible will take part. The entrance fee will be 2s. 6d. each, which sum should be remitted to the local secretaries, together with intimation of intention to play. The competitions, in the first place, will be divided into districts, and the following have kindly consented to undertake the duties of local secretaries:—*Glasgow*—Mr. H. W. Bewsher, 147, St. Vincent Street, Glasgow, C.2; *Edinburgh*—Mr. H. V. Henniker, c/o Messrs. Bruce Peebles & Co., Ltd., Edinburgh; *Dundee*—Mr. P. Philip, c/o Corporation Electricity Department, Dudhope Crescent Road, Dundee; *Aberdeen*—Mr. J. Alexander Bell, Corporation Electricity Works, Milburn Street, Aberdeen. Returns must be made to local secretaries before May 31st, 1928.

Electricity Charges in South London.

A meeting, convened by the Camberwell, Peckham and Dulwich Chamber of Commerce, of all traders in South London, was held at the Central Hall, Peckham, S.E., on April 16th, when protests were made against the high charges for electricity. Councillor H. F. A. Edmonds (Camberwell) proposed the following resolution: "This meeting of the Camberwell manufacturers, traders and business men, convened by the Camberwell, Peckham and Dulwich Chamber of Commerce, protests against the excessive prices charged to them by the County of London Electric Supply, Ltd.; the London Electric Supply Corporation; the South London Electric Light Corporation; and the South Metropolitan Electric Light and Power Co.; and calls upon the Minister of Transport to institute an inquiry into the question." The resolution, which also provided that copies should be sent to the local members of Parliament, the L.C.C., and the South London Borough Councils, was adopted.

The Batti-Wallahs' Society.

This Society will hold a luncheon at the Hotel Cecil on Wednesday, May 16th, at 1 p.m., at which Mr. Ll. B. Atkinson will give an address on "Electrical Industry—where do we stand to-day?"

Mr. Whitgift, the hon. secretary, informs us that the recent annual dinner and dance was very successful. In order to avoid clashing with other fixtures next year it has already been decided to hold it on March 1st, 1929.

Appointments Vacant.

Showroom assistant (lady) (£157) for the Burnley Corporation Electricity Department. Mains engineer for the Boston and District Electric Supply Co., Ltd. Lecturer in electrical engineering for the University of British Columbia Electrical Engineering Department. Mechanical engineer (£600) for the Electrical Branch of the P.W.D. Government of Nigeria. Electrical engineer and manager (£900) for the Borough of Leyton Electricity Department. Shift charge engineer for the Kingston-on-Thames Corporation Electricity Department. Assistant signal and telegraph engineer (Rs.450 per mensem) for the South Indian Railway Co., Ltd. Fitter stoker for the Hertfordshire County Sanatorium, Ware. Cable jointer for the Burnley Corporation Electricity Department. Junior mains assistant for the Aylesbury Corporation Electricity Department. (See our advertisement pages to-day.)

A Large Electric Coal Hoist.

In a paper on the "Bulk Handling of Ore, Coal and Grain," by Mr. H. H. Broughton, read before the London Branch of the Association of Mining Electrical Engineers, some interesting particulars are given of a large electrically-driven hoist which is installed at a coal mine in Illinois. It is an equalised Ward-Leonard machine designed for a maintained output of 1,500 tons per hour from a vertical depth of 607 ft. The bicylindro-conical drum is directly driven by two 2,000-h.p. motors running at 75 r.p.m., and the maximum hoisting speed is 4,000 ft. per min. The net winding time is 17 sec., and 9 sec. are allowed for unloading. On three successive days the average daily tonnage hoisted was 12,444 tons, which corresponds to 1,555 tons per hour. During acceleration the load is about 8,000 h.p., and during retardation the regenerative load is 4,000 h.p. Energy is supplied to the winder motors through a flywheel motor-generator set equipped with two 1,800-kW ± 600-volt variable-voltage dynamos driven by a 2,200-h.p., 2,200-volt, three-phase, 60-cycle induction motor running at 600 r.p.m. The steel-plate flywheel has a diameter of 12 ft. and weighs 90,000 lb. Notwithstanding the variation in horse power of the winder motors at different parts of the cycle, the power drawn from the three-phase supply is practically constant at about 2,000 h.p. Some particulars are also given of an equalised Ward-Leonard rock hoist which is installed at a copper mine in Arizona. This is one of a number of automatic hoists that have been installed, and is designed for lifting a net load of 24,000 lb. from a vertical depth of 1,700 ft.; the output is 625 tons per hour. The machine has twin cylindrical drums, each 12 ft. in diameter and 8 ft. wide. One of the drums is clutch-connected to the shaft, and the directly-coupled driving motor is rated at 2,150 h.p. The automatic controller is actuated by a pilot motor, the circuits of which are closed initially by a master controller and subsequently by the travel of the two skips in the shaft. As long as the controller is set for automatic operation hoisting continues automatically with definite intervals for loading and unloading. The hoist can also be manually operated if desired. Emergency and safety devices protect the hoist against a variety of contingencies, and in such cases the power is cut off and the brakes are applied.

Fatality.

An adjourned inquest was held at Annfield Plain (County Durham), on April 17th, on Robert Wilson, a shifter, who died whilst following his employment in the Brass Thill seam, South Derwent Colliery, on March 24th. The inquest had been adjourned from March 27th for an examination and report by a Government expert as to the possibility of the presence of electricity in a circuit stated to have been cut off from contact in July of last year. At the opening of the inquest, Thomas Hunter, a shifter, had given evidence that Wilson took hold of a tube encasing electric wires and immediately gave a great sigh. Dr. Parry, who made a post-mortem examination, had stated that the result was not satisfactory, and he and two other doctors had failed to find the cause of death. He was not prepared to say whether electricity had caused death. The principal witness at the adjourned inquiry, Mr. A. B. Horsley, Electrical Inspector of Mines, said that he had inspected the electrical apparatus at the pit and was satisfied that there was no electrical pressure on the wires. He inspected for defects in the insulators which might have caused an intermittent contact, but found none, and was satisfied that Wilson could not have received an electric shock from the tubing. Dr. Parry, recalled, said that he found no evidence of electric shock, and that in his opinion death was due to heart failure. A verdict of "Death from natural causes" was returned.

Low-Temperature Carbonisation.

In a joint paper by Mr. R. P. Wilson, C.B.E., and Mr. C. H. Parker, read recently before the Institution of Engineering Inspection at the Royal Society of Arts, the authors outlined some of the advantages obtained from the low-temperature carbonisation of fuel. Dealing with the future of "coalite" as a domestic fuel, the authors said that the well-designed domestic grate, burning the right kind of smokeless fuel, would apparently always be the most satisfactory means of heating an ordinary living room. The volatile content of domestic fuel turned out by low-temperature carbonisation processes was from 6 to 8 per cent.; there was no virtue in leaving a greater volatile content, but it was necessary to leave about that amount. In the course of the discussion Colonel Bristow said that the low-temperature carbonisation plant in operation at Barugh distilled 1,500 tons of coal per week, and produced about 1,000 tons of "coalite." Mr. Wilson, answering a question concerning the suitability of coalite for pulverising, said that the "fines" were in themselves 80 per cent. pulverised, and they were not susceptible to the absorption of moisture to anything like the same extent as small fine coal during the process of pulverisation. Again, pulverised coal made from ordinary raw coal was liable to spontaneous combustion, because it contained a very large percentage of volatile matter, but the percentage of volatile matter in "coalite" was about 6 per cent., and therefore it was not liable to spontaneous combustion.

Industrial Electrical Heating Apparatus.

Some interesting details are given on the above subject in an article in *Chemical and Metallurgical Engineering* by Mr. K. A. Carleton. It is frequently true that the superior product which may result from the use of electrical heat, or the labour saving thus made possible, will actually bring about a reduction in over-all costs. In other cases the necessity for very close control, the requirement of high process temperatures, or quick heating and cooling, or the existence of a fire hazard, may swing the balance in favour of electrical heating. Electrical resistance heating may be said to be of three types, that in which the material undergoing process serves as the resisting element, indirect electrical heating where energy is made to heat elements which are in contact with the processing container, or otherwise separated from the material being treated, and that in which some integral part of the container serves as the resistor. The first method is probably ideal in the few instances where it can be used. The second has wide application, but presents the disadvantages that uniform temperature distribution is almost impossible of attainment, that hot spots are difficult to prevent, that heating elements are likely to burn out, that the elements are limited in their current-carrying capacity, that rapid temperature variations cannot be obtained, and that closest control is not possible because of the lag inherent in the method. Such equipment is also, of necessity, quite costly. Many attempts have been made to adapt the third method to industrial use, and low-voltage apparatus in which high power factors are attainable through the virtual elimination of self-inductance have been developed. The possible applications of this principle of heating are many and varied and apparently limited only to the ingenuity of the designer. The heating element is of comparatively high resistance, and where this does not include the shell, the latter is constructed of material having the lowest resistance consistent with the other physically or chemically resistant properties required. Low self-inductance is made possible through the expedient of doubling back the circuit on itself as frequently as possible, and where the container forms the resistor it is made double-walled, with the heating surface proper of high resistance, and the false shell, electrically connected at one end, of low. When tubes form the heating element, the shell may be made the low-resistance side, serving to neutralise self-inductance, or the tubes may be so arranged and electrically connected that the current flow is opposite in adjacent tubes. The principle is susceptible of use in connection with sources of any available current, direct or alternating, single or polyphase. Direct-current sources must obviously supply a suitable low pressure of a few volts. While the secondary current is necessarily large, losses in the inactive parts of the circuit are made relatively unimportant by the use of low-resistance materials and current paths as short as possible. The fact that several of the best materials from the standpoint of resistance to corrosion, for example, Monel or high-chrome steels, are also of relatively high electrical resistance, is fortunate. They are obtainable in various forms of very uniform thickness, making possible the fabrication of equipment for many process uses. A practical adaptation of the system is to a paper-machine dryer roll. The outer surface of the roll forms the resistor, while the circuit is completed to a transformer mounted inside the roll by means of two low-resistance cylindrical sections joined to the outer shell at the ends, but insulated from it elsewhere. The average roll temperature is measured and controlled by a thermal element of the gas- or oil-filled variety encircling the heating surface and in close contact with it.

Radio Service in Hotels.

The largest system of radio installations in the world, it is said, has just been completed in a group of American hotels at a cost of over a million dollars. The system installed is unique, many of the features being patented, and gives a choice of two programmes in every one of the 7,700 guest rooms in all the Statler hotels situated in Boston, New York, Buffalo, Cleveland, Detroit, and St. Louis. Mr. Statler requested Mr. Karr Parker, consulting engineer for the Hotels Statler Company, to devise a radio system which should provide the very best reproduction of music and speech with accuracy and clarity, be simple to operate, so that anyone could get good reception, and enable the music of the hotel orchestra or speeches in the dining rooms to be transmitted to all the guest rooms, besides providing for radio reception and amplification on such a scale that music and speech could be heard throughout the public parts of the hotels. The system was installed during the construction of the new Hotel Statler in Boston, and the service was put in operation when that hotel opened in March, 1927. In view of the success of the experiment Mr. Statler directed Mr. Parker to put similar installations in all the other Statler hotels. The work involved the use of 6,378 miles of special wire and cable, nearly six million feet of steel conduit, 152,860 terminals, 6,552 programme selectors in the guest rooms, 1,156 loud-speakers of various types and sizes, and 6,552 special double headsets. Two hundred electricians were required to carry out the work by January, 1928.

A control room is provided in each hotel, where an operator is on duty from 10 a.m. to midnight. The receiving sets are of the Western Electric Commercial type and extremely sensitive and selective, so that programmes can be received from stations hundreds of miles away without interference while a local station is broadcasting on the roof of the hotel. From the main distribution panel in the control room lead-covered feeder cables run to local distributing panels on the various floors, which in turn distribute to the guest rooms. One set of feeders operates the loud-speaker system and a separate set the head-set system, which is independently regulated.

It was found by test that it was impracticable to use loud-speakers in all rooms in a large hotel, because of the aggregate volume of sound, so the speakers were distributed throughout the house in the larger rooms and suites. A public-address system is installed in the main dining room, ballroom, &c., of each hotel, and microphone outlets are scattered throughout these rooms, so that at any banquet or function, addresses can be broadcast and also the voice of a speaker amplified so that he can plainly be heard throughout the room and also in the other rooms of the hotel.

An Historic Dock Put to a New Use.

The old dock at the Camber, Portsmouth, which has been used as a dry dock for very many years, is soon to be put to new uses. The Portsmouth City Council, at its last meeting, accepted a tender for alterations, including the provision of a new caisson and the lowering of the sill of the dock, which, when completed, will admit of steamers of 1,000 tons capacity being berthed. The dock was taken over by the Electricity Committee in connection with a greatly extended scheme of coal-handling plant. Colliers will be berthed and by means of the new plant rapidly unloaded, and the coal will be conveyed direct to the generating station, which is situated but a short distance from the dock. The unloading will be undertaken at the rate of 100 tons an hour in order to ensure the dispatch of the vessel on the next high tide.

A Diesel-Battery Locomotive.

An interesting development in the railway world is a "self-contained" Diesel-electric locomotive which has recently been put into commission for shunting purposes in the New York Central Yards. In addition to the Diesel generating set, it is also equipped with a 218-cell, 432-V Exide battery. This is sufficient to supply the driving motors during normal working, and during heavy loads the Diesel set and the battery work in conjunction. When the locomotive is standing, or during light load, the battery is charged by the oil-driven generator.

Educational.

Polytechnic, Regent Street, W.—School of Electrical Engineering.—A special course of six lectures on "Thermionic Valves and their Uses in Wireless and Electrical Engineering" will be delivered by Mr. W. H. Date on Wednesdays, commencing May 9th, at 6.30 p.m. Fee for the course, 7s. 6d. (See our advertisement pages to-day.)

Chemical Industry Conference.

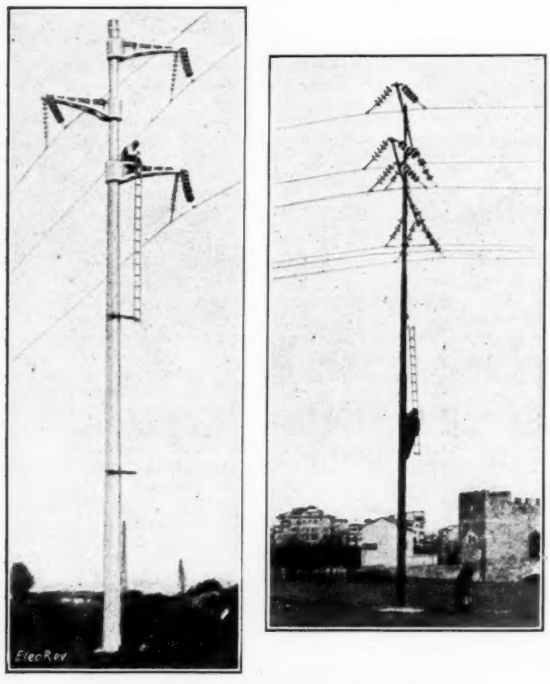
The Rt. Hon. the Earl of Balfour, K.G., O.M., in the course of his Messel Memorial Lecture in July, 1926, expressed his apprehension as regards the power of British chemists to apply scientific knowledge to industry. This was regarded as being a friendly challenge to the chemical industry, and in response there is to be held in May (11th to 15th inclusive), in London, a Chemical Industry Conference, organised by the Society of Chemical Industry, in co-operation with its London Section and Chemical Engineering Group, and the Institution of Chemical Engineers. The first session, May 14th, will be devoted to the subject of fuel, under the chairmanship of Sir Hugo Hirst, Bart. A feature of a later session will be a paper by Sir Alfred Mond on "Scientific Research as Applied to Industry."

Paisley Association of Electrical Engineers.

At the annual general meeting of the Paisley Association of Electrical Engineers, on April 17th, Mr. J. R. Bisland was elected president for the session 1928-29.

Transmission-Mast Scaling Ladders.

We are indebted to "L'Energia Elettrica" for the accompanying illustrations of the simple means which have been devised by Signor R. Betocchi for mounting to the top of the tall electric power transmission masts in the Rome area and the Tuscany province of Italy. At regular intervals on



Scaling Poles with the Aid of a Ladder.

the masts brackets are provided which will bear the weight of a man. He is furnished with a ladder of a light, but strong, material, so that it can easily be raised and lowered by the man himself. The upper end of the ladder is provided with hooks, so that as he reaches one of the brackets he can raise the ladder to the next, and so on, in turn, until the top is reached. The system has been applied with success to both tubular-steel and ferro-concrete masts.

Electrical Breakdown Causes.

In a paper "Concerning Insurance," by Mr. J. W. MacDonald, read before the London Branch of the Association of Mining Electrical Engineers, some interesting comments are made on prevalent causes of breakdown of electrical plant. Vibration is the most deadly enemy of electrical plant; in revolving machines this may be due to a variety of causes, such as the armature or rotor not being balanced mechanically. It is very bad practice to put blobs of solder on the binder bands to correct the balance, because these bands have been known to slip, with the result that the balance of the armature is further upset. Where possible it is better to cut away than to add metal when correcting the balance. Other causes of vibration are defective gearing, clumsy belt fasteners, and vibration transmitted through the foundations from the machine driven by the motor. Vibration hardens the copper conductors, especially where they are unsupported; causes mica insulation to powder, and also damages the insulation of the conductors in the slots; results in excessive sparking at the brushes; leads to excessive wear of bearings; and often causes loosening of cores, laminations, and so on.

A fair percentage of breakdowns may be traced to the over-oiling of bearings and oil leakage. Some bearings are so badly designed that it is quite impossible to efficiently lubricate the shaft without creepage occurring along the shaft to the commutator, brushgear and field coils. The oil in itself may, or may not, have a detrimental effect upon the insulation of these parts of the machine, depending upon the class of oil used, but the real cause of damage is due to the foreign matter which the oil carries into the pores of the insulation. The foreign matter is generally found to consist of very finely divided metal due to wear of the bearings and carbon dust given off by the brushgear. Damage to the windings can best be prevented by an outer coating of varnish or enamel of a hard glossy nature which will not be readily softened by the oil used to lubricate the machine.

Damage by dampness is generally caused in a different manner than that caused by oil leakage, insomuch that surface leakage generally takes place, causing a flashover to occur, which carbonises the insulation and eventually breaks it down. Cases have been known of machines having been standing idle so long in a damp situation that when the current was switched on the fuses melted owing to the excessive current flowing to earth over the insulation, yet the insulation was not damaged by this rush of current, and after the windings had been thoroughly dried out and re-varnished the machines gave satisfactory service. A satisfactory repair cannot be made by drying out, however, if the windings have been saturated with oil.

Television Rights Sold.

At a dinner in London last week Sir James C. Percy, one of the directors of the Baird Television Development Co., who presided, announced that the American rights for certain patents of the John L. Baird system, covering transmission and reception, had been sold to Mr. N. Feldstern and Mr. H. Z. Pokress, representing a group of American financiers. Mr. Pokress is understood to have said that "the people who were with them were the people who really controlled the radio situation in America."

Fusing and Arcing Pressures.

In papers recently issued by the Safety in Mines Research Board, No. 38, "The Pressures Produced on Blowing Electric Fuse Links," and No. 39, "The Pressures Produced by Electric Arc in Closed Vessels," by Messrs. G. Allsop and R. V. Wheeler (H. M. Stationery Office, prices 1s. 6d. and 9d., respectively) various interesting experiments on the subjects are described in detail, and some interesting conclusions are drawn from the results. The majority of the tests relating to the first-mentioned paper were carried out at 210 V d.c. or 200 V a.c. 50 ∼, the available short-circuit power being limited to about 40 kW in each instance. In addition, about 25 tests were done at 730 V a.c. 50 ∼, for which the available short-circuit power was about 1,000 kW. In interpreting the results from a practical standpoint the limitations imposed by the small amount of power employed must be borne in mind, as much heavier currents than those used for most of the tests are liable to flow when a cut-out operates in service. A comparison of the results shows that fuse links used as protection on a.c. systems do not give rise to such high pressures when blown as do fuse links of the same capacity on d.c. circuits. The a.c. arc formed on the fusion of the wire is much less stable than the d.c. arc, due to the reversal of potential every half cycle. The conducting path has to be maintained during the period over which the voltage is below the arcing potential, failing which the arc is not reformed. It appears that the mechanical pressure accompanying transient arcs in closed vessels, such as are produced when fuse links are blown, is almost entirely due to metal vapour. The magnitude of the pressure varies directly with the energy released during arcing. Any means of reducing the energy of the arc therefore automatically reduces the pressure developed. For this reason, very small fuse-boxes, having relatively large cooling surfaces are effective in reducing the pressure that a blown fuse can give, as are also cartridge fuses. From a practical standpoint, however, reduction of the volume of the fuse-box is probably unsuitable for semi-enclosed cut-outs, as it might lead to "failure" of the cut-out by arcing to the case when a heavy overload occurred. Tin fuse links yielded lower pressures than copper under all conditions of experiment, and zinc fuse links lower pressures than tin. The arcing with tin and zinc fuse links is not so severe as with copper because the former metals melt and run at low temperatures, compared with that at which copper melts. When a fuse link is blown in an explosive mixture of methane and air, the burning of the gas tends to reduce the period of arcing (over the range of power used in the experiments, *i.e.*, 210 volts d.c. and currents up to 180 amps.).

It also appears that ignition of the gas does not start until the fuse link has melted and arcing has commenced, so that compression of the gas before ignition cannot occur in the true sense, though if the rate of rise of pressure due to the blowing of the fuse link is much greater than that due to

the explosive mixture, some effect due to this cause may be possible. The tests further showed that the rate of rise of pressure due to the blowing of the fuse link increases with increasing blowing current, and, to study the effect of a more rapid rate of pressure rise due to this cause, an extension of the tests using currents up to about 10,000 amps. is under consideration.

The pressure developed by arcing within an air-filled switch casing appears, from the experiments described in the second paper, to be due to the heating effect of the arc, and mainly caused by the vaporisation of metal. In the tests made, the pressure appears to be dependent on the total watt-seconds of arc energy, but the exact relationship cannot be determined from the data available. Up to the limit of power used in the experiments, 1,350 A at 575 volts, no dangerous pressure will be produced in apparatus by arcs, provided an adequate circuit-breaker is in the system. If the arcing be prolonged owing to failure of the circuit-breaker to operate, dangerous pressures may be produced. In one case a ¾-in. arc holding for about half a second gave rise to a pressure of nearly 140 lb. per sq. in. With the same power and the same voltages, it is clear that arcing in a.c. circuits is much less severe than in d.c. circuits. Any danger due to pressure as the result of arcing is in consequence much less with alternating than with direct current.

Institution Notes.

Institution of Electrical Engineers.

INFORMAL MEETING.—At the informal meeting on April 16th, Mr. M. Whitgift was in the chair when Mr. E. H. Shaughnessy, O.B.E., opened a discussion on "Wireless Reception," dealing with this popular subject from an unfamiliar aspect. He spoke from the point of view of a telegraph engineer, in opposition to that of the broadcasting man, and asked for more consideration for the important and essential telegraph and telephone services from "a spoilt public indulging in more or less musical and other broadcast entertainment." He frankly declared for spark transmission, in preference to the interrupted continuous wave, and complained of the monopoly, by broadcasting, of the ether, which had become so crowded with long-waves that the G.P.O. had had to put its stations 200 cycles apart.

This was the final meeting of the session.

SOUTH-MIDLAND CENTRE.—The report of the Committee on the 1927-28 session, which was to be submitted to the annual general meeting in Birmingham on April 25th shows that the number of ordinary meetings increased by one to nine, the average attendance thereat being 110. Two such meetings were set apart for the discussion of wireless subjects; at the end of the previous session it was decided to discontinue the Wireless Section which had been instituted as an experiment for one year, because, although the general attendance was good, there was a marked absence from all the meetings of the wireless members for whose benefit the Section had been established; in place thereof two wireless papers were included in the ordinary programme. Membership continues to increase, 14 during the year, the total being 1,096. A definite proposal is being discussed for securing a joint building wherein the engineering societies in Birmingham can meet. It is felt that the Centre is hardly doing its fair share as regards the provision of papers. Next year's Committee will consist of:—*Chairman*: Mr. S. H. Holden; *vice-chairmen*: Messrs. G. R. J. Parkinson and G. Rogers; *committeemen*: Drs. W. Cramp, R. G. Jakeman, J. D. Morgan, A. H. Railing, Capt. J. Coxon, Messrs. G. W. Billingham, W. Burton, F. Forrest, H. Faulkner, E. Morgan, A. D. Phillips, F. C. Platt, and J. J. Swarsbrick; *hon. sec.*: H. Hooper.

EAST-MIDLAND SUB-CENTRE.—Notwithstanding transport difficulties in the Loughborough district, the Sub-Centre is virile; nine meetings were held at four towns.

SOUTH MIDLANDS STUDENTS' SECTION.—Some dislocation was caused at the beginning of the session owing to the sudden departure from Birmingham of the incoming chairman, ex-chairman, and hon. secretary. However, a full programme was carried out, nine meetings being held.

MERSEY AND NORTH WALES (LIVERPOOL) CENTRE.—The annual general meeting was held on April 16th, when the undermentioned officers were elected to fill the vacancies on the Committee for the 1928-29 session:—*Chairman*: Mr. S. E. Britton; *vice-chairmen*: Prof. E. W. Marchant and Mr. P. Priestly; *hon. treasurer*: Mr. L. Breach; *hon. secretary*: Mr. O. C. Waygood; *members of committee*: Messrs. E. M. Hollingsworth, A. C. Livesey, E. L. Morland, and F. E. Spencer.

Diesel Engine Users' Association.

At the meeting which is to be held on Tuesday, May 1st, a paper entitled "Some Considerations Regarding the Peak-load Problem, and High-powered Peak-load Diesel Engines," is to be read by Mr. M. Gercke, technical adviser on power-station practice to the M.A.N. Company of Nuremberg. Visitors interested in the subject can obtain tickets from the Association at 19, Cadogan Gardens, London, S.W.3.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

It is announced that the EARL OF VERULAM (chairman of the Enfield Cable Works, Ltd.) and Mr. A. J. T. TAYLOR (managing director of the Underfeed Stoker Co., Ltd.) have joined the board of Sir W. G. Armstrong, Whitworth and Co., Ltd.

On the occasion of the marriage, on April 7th, of Mr. CLIFFORD BOOTH, chief assistant engineer at the Spenborough electricity works, to Miss EDNA BRUCE, daughter of Mr. Rowland Bruce, Dewsbury, the electricity staff presented Mr. Booth with a mahogany timepiece.

The *Yorkshire Post* states that Mr. MAURICE S. GIBB, managing director of the Central Marine Engine Works, West Hartlepool, has been re-elected president of the North-East Coast Institution of Engineers and Shipbuilders.

On the occasion of his marriage, on April 14th, to Miss D. F. SHIELDS, Mr. SAMUEL NOEL BOYNE, of the staff of the Clacton-on-Sea Urban Council's Electricity Department, was presented by the staff and employés with a canteen of cutlery and a clock.

Mr. FREDERICK W. MAYNARD, of Silverdale, has been appointed electrical engineer at the Earl of Dudley's Baggeridge Colliery at Sedgley.

In consequence of the adoption by the Leyton Town Council of the Local Government and other officers Superannuation Act, 1922, Mr. F. HARMAN LEWIS, electrical engineer and tramways manager, will retire in June next after 29 years' service.

Mr. HENRY UNDERWOOD, late boiler-house superintendent at the Greenwich power station of the L.C.C. tramways, who has retired after over 25 years' service, has been presented by the officers of the electrical branch and the staff and employés with a gold watch.

Mr. J. A. FORDE, engineer and manager of the Isle of Thanet Electric Supply Co., Ltd., has been elected chairman of the Broadstairs and St. Peters Urban Council.

Mr. C. G. ABBEY, managing director of the Lancashire Dynamo and Motor Co. of Canada, Ltd., sails from Montreal to-day (April 27th) in the s.s. *Aurania* for London. He expects to be in England for about three weeks, at the works of the parent company in Trafford Park and Willesden.

Mr. ARTHUR FODEN has been appointed station engineer to the City of East London Municipality, South Africa. He has left the Southport Corporation Electricity Department, and sails by the *Balmoral Castle* on May 4th.

Obituary.—MR L. HOAD.—*The Times* "Deaths" column reports that Mr. Lewis Hoad, late master of the cableship *Telconia*, of the Telegraph Construction and Maintenance Co., Ltd., passed away on April 15th at Gibraltar.

MR. D. ROBERTS.—We regret to record the death of Mr. David Roberts, which occurred on April 22nd at Grantham, in his 70th year. Mr. Roberts was for many years managing director of Messrs. R. Hornsby & Sons, Ltd., and latterly a director of Messrs. Ruston & Hornsby, Ltd.

MR. F. M. T. LANGE.—We regret to record the death of Mr. F. M. T. Lange at his London residence on April 17th, at the age of 71. Mr. Lange was educated at Cambridge University and at the Crystal Palace School of Engineering, and entered the electrical industry, being engaged on the applications of electricity to lighting and power for some time in France, and subsequently in England as a partner in the firm of Geipel and Lange. Later he went to China, and carried on a similar business for some ten years; returning to this country, he was appointed secretary and manager of the Representation of British Manufacturers in the East. Mr. Lange was a member of the Institution of Mechanical Engineers and of the French Institute of Civil Engineers, and Associate Member of the Institution of Civil Engineers. He was highly esteemed by his many friends, and there was a large attendance at the cremation, which took place at Golders Green on April 19th. A widow and one daughter survive him.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Essex Magneto Co., Ltd.—Private company. Registered April 16th. Capital, £2,000 in £1 shares. Objects: To acquire the business of magneto and ignition manufacturers and electrical engineers carried on at 123 and 123a, Markhouse Road, Walthamstow, as the Essex Magneto Works, and to carry on the same and the business of garage keepers, suppliers of petrol, &c. The permanent directors are:—A. T. Gardner, 2, Russell Road, Leyton, E.10; W. M. Jullyan, 40, Chappell Road, Bexley Heath, Kent; E. H. Gardner, 78, Chingford Road, E.17, all electrical engineers. Registered office: 123, Markhouse Road, Walthamstow, E.17.

Quicklix Electrical Fittings Co. (1928), Ltd.—Private company. Registered in Edinburgh, April 14th. Capital, £500 in £1 shares. Objects: To carry on the business of a store in all its branches, and that of manufacturers of and dealers in manufactured goods, raw materials, &c. The subscribers are:—J. McLean and W. McLean, 12, Woodside Terrace, Glasgow, commission agents. Registered office: 12, Woodside Terrace, Glasgow.

Gardner, Brown & Co., Ltd.—Private company. Registered March 31st. Capital, £1,000 in £1 shares. Objects: To carry on the business of experts, technical advisers, electrical, consulting, and mechanical engineers, manufacturers and repairers of and dealers in wireless instruments, gramophones, gramophone records, &c. The first directors are:—C. N. Gardner, Glen Aldred, Brancaster Lane, Purley, Surrey; E. G. Brown, 2, St. James, New Cross, S.E.14. Registered office: 131, Finsbury Pavement, E.C.2.

C. Barnett, Ltd.—Private company. Registered April 19th. Capital, £1,000 in £1 shares. Objects: To carry on the business of radio accessory dealers, electrical engineers, gramophone and musical instrument dealers and agents, &c. The first directors are:—Mrs. C. Barnett, 77, Whyteville Road, Forest Gate, E. (permanent); W. Symons, The Glen, Cliff Gardens, Leigh-on-Sea, company secretary. Registered office: 50, Angel Lane, Stratford, E.15.

Quadrant Electric Co., Ltd.—Private company. Registered April 19th. Capital, £200 in £1 shares (100 5 per cent. (free of tax) preference and 100 ordinary). Objects: To carry on the business of manufacturers of and dealers in electrical components, parts, fittings and fixtures of all kinds, &c. The directors are:—H. B. Silver (chairman and permanent joint managing director), 105, Harrow View, Harrow; C. Fleet (permanent joint managing director), 15, Bessborough Road, Harrow. Registered office: 61, Station Road, Harrow.

G. J. Scragg & Co., Ltd.—Private company. Registered April 12th. Capital, £3,000 in £1 shares. Objects: To acquire the business of electrical and mechanical engineers and contractors now carried on by G. J. Scragg and H. H. Holloway at Holywell, Flintshire, and at Denbigh, as "G. J. Scragg and Co." The permanent managing directors are:—G. J. Scragg, Isfryn, Holway, Holywell; H. H. Holloway, The Hetlands, Holway, Holywell. Qualification: £500 shares. Solicitor: C. Jones, "Pendre," Holywell.

Wall's (North Wales), Ltd.—Private company. Registered April 10th. Capital, £1,000 in £1 shares. Objects: To carry on the business of electrical, wireless and mechanical engineers, contractors and merchants, dealers in electrical fittings, &c. The first directors are:—A. E. Maybury, "Cherisy," Bishops Wood Road, Prestatyn; J. N. Jackson, "Wayside," Gronant, near Prestatyn; T. Airey, 16, Victoria Avenue, Prestatyn (all permanent, subject to each holding 200 shares). Qualification of ordinary directors, 50 shares. Manager: A. E. Maybury. Registered office: Devonshire House, High Street, Prestatyn, North Wales.

Jones Bros. (Blackpool), Ltd.—Private company. Registered April 14th. Capital, £5,000 in £1 shares. Objects: To adopt an agreement with A. F. Kershaw and H. H. Pearson, and to carry on the business of electricians, electrical and wireless engineers, manufacturers of and dealers in electrical apparatus, ironmongery, hardware, refrigerators, &c. The first directors are: A. F. Kershaw, "Hilldene," 2a, Victoria Avenue, Blackpool, electrical engineer; H. H. Pearson, A.M.I.E.E., Brentwood, Manor Road, Blackpool (both permanent, subject to each holding 1,000 shares). Secretary, H. H. Pearson.

Remployed, Ltd.—Private company. Registered April 16th. Capital, £100 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in electro-thermic quilts, blankets, cushions, rugs, bed warmers, and the like, and to acquire so much of the business carried on in connection therewith and the trade mark "Thermega" as relates to such manufacture or has hitherto been carried on by Thermega, Ltd. The first directors are: R. Millbourn, 106, Oakwood Court, Kensington, W.14, stockbroker; A. K. Watson, Garvald, Dolphinton, Peebleshire; C. D. Uniacke, Whitegate, Camberley; E. Howard, 94, Petty France, Westminster, S.W. (general secretary, Thermega, Ltd.). Registered office: 94, Petty France, Westminster, S.W.1.

Abbey Electrical Co., Ltd.—Private company. Registered April 14th. Capital, £500 in £1 shares. Objects: To adopt an agreement with Paul Schroeder, of Feurbach, Stuttgart, Germany, and to carry on the business of manufacturers, repairers, importers and exporters of, agents for and dealers in all kinds of electrical, mechanical, or engineering apparatus, electrical or other switchboards, radio apparatus, &c. The first directors are: J. E. Sawyer, West Drayton, manufacturers' agent; B. T. Wingfield, West Drayton, engineer. Secretary, H. Wilding. Registered office: 316-323, Abbey House, Westminster, S.W.1.

Electric Mirrors, Ltd.—Private company. Registered April 19th. Capital, £1,000 in £1 shares. Objects:—To acquire the business of an advertising contractor and licencee of illuminated electric-controlled mirrors carried on by J. H. Lipman at 66½, Corporation Street, Birmingham, and to carry on the same and the business of manufacturers of, agents for, and dealers in electrical and other signs, &c. The first directors are:—J. H. Lipman, County Chambers, Corporation Street, Birmingham, advertising contractor; J. Passey, 71, Temple Row, Birmingham, solicitor. Qualification, 50 shares. Solicitor: J. Passey. Registered office: County Chambers, Corporation Street, Birmingham.

Official Returns of Electrical Companies.

Shoreham and District Electric Lighting and Power Co., Ltd.—Issue on March 31st, 1928, of £600 debentures, part of a series already registered.

Edison Swan Cables, Ltd.—Trust deed dated March 24th, 1928 (supplemental to trust deed dated November 24th, 1927, securing £250,000 debentures), charged on certain properties at Ashfield, Ross, Herefordshire. Holders:—London Trust Co., Ltd., 14, Austin Friars, E.C.

Axuel Time Switches, Ltd.—Debenture dated March 20th, 1928, to secure £235, charged on the company's undertaking and property, present and future, including uncalled capital. Holder:—F. N. Wilson, 54, The Avenue, West Ealing, W.13.

Haworth & Williams, Ltd.—E. Hope, 20, Willow Street, Accrington, ceased to act as receiver or manager on April 5th, 1928.

Hungerford and District Electricity Supply Co., Ltd.—G. Weir, C.A., of 60, Stanhope Avenue, Finchley, N., was appointed receiver and manager on April 5th, 1928, under powers contained in instruments dated August 17th and November 25th, 1927, and March 21st, 1928.

N.K. (Bradford), Ltd.—R. G. Sidford, 76-86, Strand, W.C.2, was appointed receiver on April 4th, 1928, under powers contained in debenture dated June 15th, 1927.

Korting Brothers (1917), Ltd.—Satisfaction in full on April 2nd, 1928, of debenture dated April 27th, 1927, securing £1,000.

Resisto Electric Wire and Tape Co., Ltd.—Capital, £500 in £1 shares. Return dated January 13th, 1928. All shares taken up. £500 paid. Mortgages and charges, nil.

Bann Syndicate, Ltd.—Capital, £10,000 in £1 shares. Return dated January 12th, 1928. 8,002 shares taken up. £8,002 paid. Mortgages and charges, nil.

Automatic Coil Winder and Electrical Equipment Co., Ltd.—Capital, £10,000 in 8,000 ordinary and 2,000 deferred shares of £1 each. Return dated March 12th, 1928. All shares taken up. £3,000 paid, £7,000 considered as paid. Mortgages and charges, £2,300.

Credenda Conduits Co., Ltd.—Capital, £50,000 in £1 shares. Return dated January 13th, 1928. All shares taken up. £30,000 paid, £20,000 considered as paid. Mortgages and charges, nil.

Rural Electricity Supply Co., Ltd.—Capital, £10,000 in 9,500 preferred shares of £1 each, and 10,000 deferred shares of 1s. each. Return dated October 29th, 1927. 5,512 preferred and 5,713 deferred shares taken up. £3,156 13s. paid on 2,871 preferred and 5,713 deferred shares, £2,641 considered as paid on 2,641 preferred shares. Mortgages and charges, nil.

Midland Manufacturing Co. (1922), Ltd.—A. L. Gibson, C.A., of 9, Paradise Square, Sheffield, was appointed receiver and manager on April 11th, 1928, under powers contained in debentures dated April 4th, 1923.

Hastings and District Electric Tramways Co., Ltd.—Trust deed dated March 20th, 1928 (supplemental to trust deed dated January 20th, 1905), to secure £200,000 debenture stock, charged on the properties comprised in the original trust deed. Trustees.—Debenture Securities Investment Co., Ltd., 21, Moorgate, E.C.

City Notes.

British Electric Transformer Co., Ltd.

The annual meeting was held on April 17th, Mr. A. F. Berry (chairman) presiding. In moving the adoption of the report (ELEC. REV., April 13th, p. 653), the chairman made reference to the "Tricity" restaurant, which, although not at present very profitable from the dividend point of view, was an effective guide to their showrooms and offices, and had been a valuable business-assisting asset. The restaurant also had potential financial value.

As furnishing an example of the use of electrical equipment in restaurants, it had already proved its value in helping them to secure orders. He had told them last year how low prices were, and that to make ends meet would be difficult in some cases. The volume of business was, as he foreshadowed, not too bad, but the margin of profit was meagre. During the whole of 1927, in common with many others, they felt acutely the disastrous after-effects of the coal strike of 1926. The effect on their trade was twofold, owing to the dislocation of the iron and steel trades. Then again big schemes involving the use of transformers were held up, and it took the greater part of the year to get back into anything like normal working conditions. Their heating and cooking business, which had been of great value to the public during the period when coal was dear and scarce, was slowed up badly for several months in the early part of the year, and had barely recovered yet. Many supply undertakings had raised their prices for electricity for heating and cooking at about the same time that the coal owners found it impossible to dispose of their rapidly-increasing stocks except at a low price. The public naturally returned to the use of cheaper coal. Supply undertakings were now getting back to the policy of very much cheaper rates for domestic supply. The effect of that would undoubtedly be to stimulate a steady increase in the use of the appliances which the company manufactured; they were already making good progress again in that department of the business. At the moment, apart from strenuous competition, there were indications that they had surmounted the worst of their difficulties. In the transformer business, however, competition had been pushed to a limit beyond that which was either fair or reasonable. The desire to break any form of co-operation which might reduce costs and permit the payment of a fair wage had, unfortunately, been strongly marked with some of their big buyers. The comparatively recent references in the Press to certain railway contracts would be fresh in their minds in that connection. He would ask those of them who had influence with big public carriers to impress upon them that to keep work in this country was to enable them to reduce their standing charges and costs, to pay increased wages and dividends, and so increase the spending power of the public upon which the dividends of the railway companies and others depended. The engineering industry depended in part upon its exports, and the policy of other competing nations affected it immediately. Our own national post-war policy had been definitely and deliberately in favour of the restoration of national credit at the expense of industry and manufacture. Thus, while our financial position had been bettered, our industry had been badly hit. Finance could always recover more quickly from depression than industry could. The depression of industry had caused a competition for orders which had nearly destroyed co-operation, left us without profits, and so affected the life blood of industry that research and kindred revitalisers could not be paid for. As a very efficient manufacturing country America did not find it so convenient to accept goods as to accept a controlling share in certain industries. By that means their home investments and factories might be made still more remunerative, and a control of export business for the rest of the world arranged. To-day's invasion by foreign capital, though different, might prove beneficial ultimately, but to allow themselves to beggar one another and so reduce prices of their business to a willing buyer who was also very shrewd and able, could not possibly be wise. The interest being taken by the large American financial houses in English electrical manufacturing industry was indeed a compliment, and should enable them to put a proper value upon their undertakings. Turning to the company's immediate prospects, so far this year it had received considerable orders, but at very poor prices. In view of the crushing burdens that were upon them in the way of taxation and the operation of the national and international policies regarding their industry to which he had referred, it was becoming increasingly hard to earn an adequate return on ordinary share capital. On the other hand, such was the inherent strength of the company that through the operation of the law of "survival of the fittest" reasonable dividends should be earned in due course.

International Aluminium Co., Ltd.

The annual meeting was held on April 19th. In the course of his speech, the chairman (Mr. K. M. Clark) said that although the accounts covered a period of 14 months, it was not until May last that the works commenced operating at full capacity after the reconditioning of the plant at Hebburn. The continuous running and increased production had fully justified the work which had been done. The disposal of the whole of the output was assured by their contracts with the A.S. Haugvik Smelteverk and the Aluminium Corporation, Ltd. The former company was constituted as a Norwegian subsidiary in order to take over a 55-years' lease of a fully-developed hydro-electric undertaking with factory buildings, haulage railways, wharves, &c., and it commenced operations in October last. Since January the works had been running at their full capacity, producing 300 tons of metal per month. Under the concession they were obliged to take up 50,000 h.p. (36,000 kW) by 1932, and they proposed at first to do this in 9,000-kW stages. It was considered possible and advisable, however, to proceed more quickly, and an initial supply of 12,000 kW had been taken; the second stage of development would call for a further 12,000 kW. Realising that with the inauguration of the Norwegian works the requirements in alumina would far exceed the capacity of the Hebburn works, the company had acquired land situated on the Menai Straits for a factory. To meet requirements in the meantime a long-dated contract had been entered into with Continental manufacturers, but as this required the company to restrict its own manufacture to the Hebburn works, the proposal to build a new factory had been abandoned. It had also been decided to wind up the French company (S.A. des Bauxites du Var). They intended to pay the dividend half yearly on the 7 per cent. cumulative participating preference shares (into which the 10 per cent. preference shares were converted). The prospects of a satisfactory ordinary dividend at a no very distant date appeared to be distinctly promising.

Brompton and Kensington Electricity Supply Co., Ltd.

This company's report for 1927 was reviewed in our issue of April 6th (p. 609). The annual meeting was held on April 19th, when Mr. H. R. Beeton (chairman), who presided, explained the system governing the rate of dividend under the London Electricity (No. 2) Act. He said that under that arrangement it was the company's aim to reduce costs by more efficient production while the consumers' part was to assist by increasing their consumption; there were already indications that they realised that the more they consumed the cheaper electricity became. So far the company had not been able to take a bulk supply as the other London companies were doing. They had first to erect a bulk-distribution station and complete arrangements for taking supply at the standard frequency. The work was now in active progress. The cost of the bulk-distribution station, which would be one of the most up-to-date of its kind, was being met from their own resources; the cost would be about £40,000. With regard to the cost of standardising the frequency—about £20,000—they could look to the London Power Co. Although they had not benefited from consolidated generation, they had substantially reduced prices and meter rentals. The increase in distribution costs which they had incurred was mainly due to higher rates and taxes, which represented more than a halfpenny per kWh. The chairman, referring to the closing down of the Brompton and Kensington Accessories Co., said that much of the work of that company, though highly contributory to the sale of energy, had been in itself unremunerative, and in assuming its assets and liabilities they would take over an accumulated debit balance, which had, in fact, been incurred for their benefit. The setting free of the constituent companies from the immediate responsibility of generation would enable them to concentrate on distribution and bring about a considerable extension in the use of electricity.

Chelsea Electricity Supply Co., Ltd.

Mr. W. R. Davies (chairman) presided at the annual meeting on April 19th, and in presenting the report and accounts (ELEC. REV., April 13th, p. 653) said that they were now beginning to obtain some slight benefit from consolidated generation through the London Power Co. The cost per kWh sold had fallen from 2.90d. to 2.47d. At present they could not look for an increase in the dividend, but they hoped to be able to progressively reduce their charges to consumers, and they also hoped that the reduction in the cost of energy and the increase of business would counterbalance the effects of the reduced prices. Referring to the Press agitation upon the subject of electricity charges, Mr. Davies pointed out that substantial reductions had already been made; that the companies were anxious to reduce prices as fast as possible, consistent with their being able to maintain the moderate dividends allowed by the 1925 Acts; and that electricity was about the only manufactured commodity in general use which was obtainable at below pre-war prices. He expressed the hope that the settlement of their affairs with the L.C.C. and the Electricity Commissioners would not be delayed much longer. The business had expanded steadily, and the progress should be maintained. The interconnection of the generating stations had already proved of great value. In conclusion, he referred to the projected station of the London Power Co. at Battersea and expressed his appreciation of the work of the staff. Sir T. O. Callender seconded the motion, and the report and accounts were adopted.

British Columbia Electric Railway Co., Ltd.

In a recent circular to the shareholders, the directors made reference to the offer by Lord Rothermere and associates to purchase the preferred and deferred ordinary stocks at the respective prices of £240 and £280 per cent. They asked shareholders to defer replying to the offer as they had been approached by other responsible parties and might be in a position to communicate a more favourable proposal shortly.

Later circulars issued by the secretary of the company stated that an offer of £266 per £100 of preferred stock and £306 per £100 of deferred stock and shares had been received by the directors and accepted in respect of their own holdings. The offer, which was conditional on the holders of 75 per cent. of the stock and shares accepting the same, was made by the well-known firm of Nesbitt, Thomson & Co., of Montreal, in conjunction with the Power Corporation of Canada, and accompanied by the deposit of £1,000,000. The directors pointed out that this offer was much more favourable than the offer communicated to holders by Messrs. Deacon & Co., as it was £26 per £100 of stock higher. The offer to the stockholders stated that the purchase was to be completed on May 31st, or a later date to be agreed upon. As compensation for loss of office the directors are offered £7,500 each, with an extra £2,500 each for the chairman and deputy-chairman.

On Monday it was announced that a third and still better offer had been advanced by the English Association of American Bond and Share Holders, the terms being £272 per £100 preferred and £312 per £100 deferred ordinary stock. Further on, Messrs. Nesbitt issued a later offer of £275 per £100 preferred ordinary, and £315 per £100 deferred ordinary, with a view to keeping control in British hands.

Lanarkshire Tramways Co.

The revenue fell during the past year from £152,984 to £139,327, but the expenses decreased to a greater extent, so that a gross profit of £8,510 resulted, as compared with a gross deficit of £11,568 for 1926. After meeting debenture and loan interest there was a balance of £3,926, against a deficit of £11,564 in the preceding year. The report states that although the result showed a material improvement, the position was still unsatisfactory on account of the continued motor-'bus competition. The bye-laws governing motor-'bus services, which came into force in August last, have so far been ineffective in reducing competition. Reference is made to the dispute with the local authorities in connection with a new bridge over the Clyde. The company's motor-'bus repair shop at Motherwell was destroyed by fire in January last, but the damage was covered by insurance. The death of ex-Provost G. F. Pollock, a local director, is mentioned, and it is stated that his place has been taken by Major R. W. Sharp.

Stock Exchange Notices.

Dealings in the following have been specially allowed by the Committee under Rule 159:—

American Telephone and Telegraph Co.—$8,017,900 capital stock in shares of $100 each.

British Automobile Traction Co.—331,704 new ordinary shares of £1 each, issued at £1 2s. 6d. per share, partly paid and fully paid, Nos. 400,001 to 731,704.

Shawinigan Water and Power Co.—317,700 new shares of common stock of no par value, issued at $50 per share, partly paid and fully paid, and fractions.

Stewarts & Lloyds.—59,000 deferred shares of £1 each, fully paid, Nos. 4,074,710 to 4,133,709.

Underground Electric Railways Co. of London.—16,130 ordinary shares of £1 each, fully paid, Nos. 5,089,868 to 5,105,997.

Para Electric Railways and Lighting Co., Ltd.

At the annual meeting on April 19th, Sir Francis M. Voules (chairman) said that although the gross income in Brazilian currency had increased, the decline of the exchange had resulted in a lower sterling profit. It was hoped that the worst slump in the company's net earnings had been experienced, but the general position had not altered greatly since June last, when the shareholders had decided to defer consideration of the directors' capital reorganisation scheme until the 1927 accounts were in their hands. The directors considered that that scheme held the scale evenly between the two classes of shareholders, but as the latter had decided not to adopt it the directors had no option but to wait until further developments justified a revision of their recommendations.

English Electric Co., Ltd.

The report for 1927 shows that after the usual provisions, including depreciation, there is a trading profit of £76,256, as compared with £10,244 in 1926. This, however, is insufficient to meet the two issues of debentures and trustees' fees, which total £122,167. It has also been decided to write off £88,493 for additional depreciation on tools, patterns, drawings, &c., making the total charges £210,660. There was therefore a loss of £134,404 on the year's working. During the year extensive reorganisation of the company's activities at the various works have been carried out, resulting in the cost of production being materially reduced. The directors have also written down to conservative figures certain stocks, the value of which has been affected either by technical changes or by increased competition, and have made provision for certain expenditure incurred previously, which, under normal circumstances, would have been spread over a number of years. The sum required for this purpose is £123,907. In addition, it has been necessary to provide for a further liability to income tax of £63,000. As a result of these provisions the balance at debit of profit and loss account brought forward from last year, which amounted to £78,591, has been increased to £399,899. Meeting: April 30th.

Indo-European Telegraph Co., Ltd.

The report for the year ended December 31st states that the company's lines have worked efficiently without serious interruption. Communication over the Black Sea (Odessa-Constantinople) cable was restored in November. The total revenue amounted to £318,140 (against £314,007 in 1926), but owing to greater expenses the balance on working was reduced from £117,597 to £105,578. After meeting income tax and adding £11,669 brought forward there is a balance of £97,491. The cost of reconstruction of the line in Russia and Poland has been written down by £20,000, and £15,000 has been handed over to the retirement trust fund. A final dividend of £1 2s. 6d. is to be paid (making 7 per cent. for the year) together with a bonus of 15s. per share, all free of tax. Meeting, April 30th.

Cork Electric Supply Co., Ltd.

The revenue for the year ended December 31st last decreased by £6,065 to £132,836, and the expenditure by £9,568 to £85,616. After meeting debenture charges, &c., and transferring £15,000 to depreciation and renewals reserve, and £7,500 to general reserve, and adding £13,768 brought forward, there remains £33,146. It is proposed to pay a final dividend of 7 per cent. on the ordinary shares, making 10 per cent. for the year (against 8 per cent. for 1926), and to carry forward £15,483, subject to additional remuneration to directors. During the year £17,673 was expended upon the lighting and power undertaking. The amount of energy sold fell from 7,424,511 to 7,293,702 kWh, but the number of passengers carried by the tramway department rose from 6,809,409 to 7,819,902. Meeting: April 30th.

City Electric Light Co., Ltd. (Brisbane).

The report and balance-sheet for the year ended January 31st last shows that after making addition to the franchise and purchasing sinking fund, renewals, replacements and contingencies account, and the employés' provident fund, there remains a credit balance of £117,257, which, with the balance brought forward from the preceding year, makes a sum of £117,306. Out of this sum was paid an interim dividend in September last, amounting to £58,628, and a final dividend of 3 per cent. on the 6 per cent. preference shares, 3½ per cent. on the 7 per cent. preference shares, and 5 per cent. on the ordinary shares, in proportion to the amount paid thereon, free of State income tax, was recommended, leaving a balance of £34 to be carried forward.

Richmond (Surrey) Electric Light and Power Co., Ltd.

The report for the past year shows that the capital expenditure was increased by £12,952 to £281,068. The amount available (including £2,652 brought forward) is £42,573. Out of this, £1,383 is put to sinking fund, £8,000 to depreciation and renewals reserve, £3,000 to taxation reserve, and £8,000 to general reserve. The directors propose a final dividend of 6 per cent. on the ordinary shares, making 10 per cent. for the year, leaving £2,190 to be carried forward. The sales of electrical energy increased from 2,713,533 to 3,142,103 kWh. The board records the death of Mr. R. Percy Sellon, a director.

Swansea Improvements and Tramways Co.

The revenue for the past year rose from £137,160 to £140,522, and the net surplus from £7,560 to £14,749. A balance of £5,130 brought forward is added, making £19,879. It is proposed to maintain the ordinary dividend at 6 per cent., to transfer £3,000 to reserve, and to carry forward £6,481. The reserve has been credited with £5,000, being the nominal value of the shares received from the South Wales Transport Co. in respect of the sale of the Mumbles Railway and Pier undertaking.

Wycombe (Borough) Electric Light and Power Co., Ltd.

The accounts for the year ended December 31st, 1927, show a balance of £15,072, after meeting debenture interest, preference dividends and taxation, and adding the amount brought forward. An interim ordinary dividend of 4 per cent., free of tax, has been paid, and a final distribution of 6 per cent., free of tax, is being made. It is also proposed to transfer £2,500 to general reserve, and £500 to the staff benevolent fund, leaving £1,272 to be carried forward.

Provincial Tramways Co., Ltd.

The report for the past year shows a profit of £15,233, to which is added £3,115 brought forward, making £18,348. After providing for debenture interest, &c., the directors propose to pay a year's preference dividend, leaving two years' arrears, and to transfer £4,000 to general reserve; £3,139 is carried forward.

Mansfield and District Tramways, Ltd.

Speaking at the annual meeting on April 17th, the chairman (Col. Sir Joseph Nall, D.S.O., M.P.) said that although there had been an improvement during the year, it was not sufficient to justify the payment of a dividend. The proceeds of an issue of 7 per cent. debenture stock had been used to repay the bank loan. It was impossible to forecast how long the present trade depression in the district would last; in the meantime every endeavour was being made to curtail expenditure without injuring the company's ability to take advantage of any improvement in industry.

Hopkinsons, Ltd.

The profit for the year ended January 31st last was £71,578. A sum of £10,000 is being transferred to reserve. A final dividend of 5 per cent. is to be paid on the ordinary shares, making 10 per cent. for the year, and a balance of £12,202 is carried forward. The report says that the after-effects of the coal dispute lasted well into the year, and normal conditions were not resumed until the latter half of the year.

Birmingham District Power and Traction Co., Ltd.

The net traffic receipts, &c., for 1927 totalled £119,914, and the surplus increased from £103,632 to £104,761. To this is added £35,953 brought forward, making £141,715. After meeting debenture interest, renewal charges, &c., it is proposed to transfer £17,619 to reserve, to pay a dividend of 7 per cent. on the ordinary shares (as for 1926), and to carry forward £45,581.

Newmarket Electric Light Co., Ltd.

The accounts for the year ended December 31st, 1927, show a net profit of £2,516, to which is added £829 brought forward, making £3,345. A dividend of 8 per cent. is being paid, free of tax, £500 is placed to general reserve, and £720 carried forward.

Cammell Laird & Co., Ltd.

This company reports a loss of £112,000 for the past year, after meeting debenture interest. The loss in the proceding year was £73,575. As before, the deficit is met from the reserve which at the end of 1926 stood at £600,000.

Callender's Share and Investment Trust, Ltd.

The directors have declared an interim dividend on all the ordinary shares at the rate of 1s. per share (5 per cent.), less tax, as compared with an interim distribution of 3 per cent. a year ago.

Winnipeg Electric Co.

The gross earnings for 1927 rose from $5,566,034 to $5,868,142 and the net surplus from $958,119 to $1,151,207. Total dividends of $2 per share are paid on the common stock and the surplus remaining is $448,860.

Montevideo Telephone Co., Ltd.

The directors have declared an interim dividend at the rate of 6 per cent. per annum, free of tax, on the ordinary shares, as in 1927.

Howard & Bullough, Ltd.

The profit for the year ended March 31st last was £139,143. A fourth quarterly dividend of 2½ per cent. is being paid.

Anglo-American Telegraph Co., Ltd.

The usual dividend of 15s. per cent has been declared on the ordinary stock in respect of the quarter ended March 31st.

Lima Light, Power and Tramways Co.

A dividend of 75 centavos (Peruvian) has been declared against coupon No. 30 of the ordinary shares.

Erinoid, Ltd.

An interim dividend of 3 per cent. has been declared, as in 1927.

Dutch Companies.

The *N.V. Hollandsche Draad en Kabelfabriek*, Amsterdam, in reporting another favourable year, states that the results were achieved in the face of keen competition. The company was still subject to the prejudicial influence of the high tariff walls with which foreign competitors are surrounded. Through the high taxes in Holland and the fact that social legislation is more strictly enforced than in other countries, the advantage is lacking of lower costs of production which otherwise should be expected from the low import duties of Holland. Efforts must increasingly be made in the direction of the most up-to-date working and in increasing the turnover; in the latter respect the volume of business in 1927 again showed an advance over the previous year. After writing off 186,000 fl. for depreciation, the accounts show net profits of 293,328 fl., and the dividend is at the rate of 7 per cent., as compared with 6 per cent. in 1926.

The *Nederlandsche Kabelfabriek* reports net profits of 1,345,000 fl. for 1927 and a dividend at the rate of 30 per cent., as compared with 24 per cent. in the preceding year.

The *Hengelosche Electrische en Mecanische Apparaten Fabriek* ("*Heemaf*"), Hengelo, reports that orders increased in 1927. The accounts show net profits of 535,000 florins, as compared with 346,000 fl. in the previous year, the dividend on the ordinary shares being 5 per cent., as against 2 per cent. in 1926.

The *N.V. Philips Gloeilampen Fabrieken*, Eindhoven, states that the favourable results obtained in 1927 were due to the improvements effected in the products, and to new inventions, particularly in the radio and X-ray branches, and they enabled all the new machinery, equipment and buildings to be entirely written off. The net profits are returned at 11,560,000 fl., as compared with 6,180,000 fl. in 1926, permitting of the payment of a dividend of 21 per cent. on the ordinary shares, against 16 per cent. in the previous year, and 9 per cent. on the preference shares as contrasted with 8 per cent. At present the company employs 12,600 workers in Eindhoven, 3,400 in Dutch subsidiary companies, and 5,500 abroad.

British Thomson-Houston Co., Ltd.

The report for 1927 has reached us at the moment of going to press, so full reference thereto is postponed until next week. The directors are unable to recommend a dividend on the ordinary shares, and £230,513 is carried forward, as against £226,468 brought in from 1926. It is stated that competition has kept prices at unreasonably low levels. Profits remain inadequate and unsatisfactory. "Preliminary arrangements have been made with other manufacturing companies which will be proceeded with as rapidly as possible, with the view of avoiding duplication of effort and unnecessary expenditure, and of effecting economies in various directions." These arrangements are progressing satisfactorily.

Calcutta Electric Supply Corporation, Ltd.

The directors recommend a final dividend of 7 per cent. (actual) in respect of the half-year, making, with the interim dividend, a total of 12 per cent. (actual) for the year ended December, 1927; also a bonus in cash of 4d. per ordinary share, both payments being subject to income tax, less Dominion relief.

Oriental Telephone and Electric Co., Ltd.

The directors recommend a final dividend of 3½ per cent. less tax on the preference shares, making 7 per cent. for the year, and one of 6 per cent. free of tax on the ordinary, making a total of 10 per cent. for the year free of tax; also a bonus of 2 per cent. on the ordinary shares free of tax.

Swiss-American Company.

Particulars were published in the financial Press last week of the Swiss-American Electric Company recently formed in Zurich by the Motor Columbus Co., Baden, and the South American Electric Co., Zurich. The capital is 92,200,000 Swiss francs, and there are three classes of shares, held respectively by the two companies named, a Swiss banking consortium and a group of American bankers. The company is to acquire, in the first instance, large holdings in the Italo-Argentine Electric Co., the Bahia Blanca Electric Co., and the Cia. Americana de Luz y Traccion, which are already under the management or control of the organising companies.

Italian Company.

The report for 1927 of the *Tecnomasio Brown-Boveri*, Milan, states that the crisis of over-production in 1927 and the difficult situation of the market did not have any serious repercussion on the company's business. Among the orders carried out were those for three alternators to be coupled to hydraulic turbines of 45,000 h.p. each, and the corresponding 237,000-V transformers. The net profits are returned at 6,036,000 lire, permitting of the payment of a dividend at the rate of 10 lire per fully-paid share and one of 2.50 lire on the last share issue.

Stocks and Shares.

MONDAY EVENING.

LITTLE sign has been given of any cessation in the public's demand for stocks and shares. The volume of business in the Stock Exchange markets continues to expand. Members of the House tell each other, and repeat the legend to their tired staffs, that this sort of thing cannot last: that the pace in the industrial market is too hot for it to continue; that something will happen to bring the present fervour to an abrupt end. Similar conditions prevail elsewhere. The New York Stock Exchange is so swamped with orders that it had to close on Saturday last to give time for the mechanical work to be overtaken. Yet for all this there are many Stock Exchange members who are nearly unemployed, owing to their being associated with markets to which public interest pays no heed. The mining markets are neglected: the less said about the rubber market, the kinder to everyone concerned.

B.C. Electric Excitements.

Another spectacular rise in British Columbia Electric Railway stocks is one of the week's outstanding features. Lord Rothermere offered 280 for the deferred stock, and 240 for the preferred. The directors issued a statement denying various rumours as to the concern having been sold, and hinted that proprietors should wait upon the course of events. Then a Montreal house bid the directors 306 for their own holdings, and 266 for the preferred. The offer was conditional upon 75 per cent. of the two classes of stock being obtained, and the Board stated that they, the Board, had accepted the bids in respect of their own holdings. The chairman and deputy-chairman are offered £10,000 each as compensation for loss of office if the scheme goes through, and the other directors are to receive £7,500 apiece. The

prices of the preferred promptly reflected the offer, on top of which, however, came another, bidding £312 for the deferred and £272 for the preferred. And after all this, the Nesbitt group, which made the second offer, advanced their bids to 315 and 275, respectively. The Board advised acceptance of these prices. A more remarkable series of bids within so brief a space of time it would be difficult to discover.

American Buying.

Exciting rises are not confined to the foreign lists. Metropolitan Electric ordinary shares are 5s. better at 50s., on unconfirmed reports that American interests are eager to acquire control, and that £3, or more, per share, has been offered for the ordinary shares. Various references were made here last year to the City impression that Americans desired to obtain a foothold in the English undertakings, although it was assumed that the prospective buyers would concentrate upon the big power propositions rather than endeavour to buy companies operating in London. The Metropolitan, like the County of London Company, stands in a slightly different category from that occupied by other London concerns, and it may be remarked, perhaps as being no more than coincidence, that there has been heavy buying of County shares within the past two or three weeks. This support of Countys some people have attributed to the fact of the company being interested in Bournemouth and Poole Electrics, where a jump of 7s. 6d. has taken place this week, following upon an earlier, equally dramatic rise. City of London Electrics are up 1s., Chelseas put on 6d., and there has been a demand for Egham and Staines Electric ordinary, on the advanced basis of 30s. Urbans at 53s. 9d. are 3/16 up. The situation bristles with interest, if the expression is allowable, and holders of any good electric shares will watch with close attention for further developments. Richmond (Surrey) Electric has raised its dividend from 9 per cent. to 10 per cent. The company is a baby of the County of London Electric. Electric Supply Corporations rose 2s. 6d. to 55s. They, also, are said to be an object of desire to American financiers

English Electric Results.

English Electric ordinary and preference gave way on the appearance of the report, which shows net profits of £76,250, an improvement of £66,000 over the previous year. The sum of £88,500 is, however, written off for depreciation; interest takes £122,166; liability to income-tax, and the adverse balance brought in, combine to raise the company's deficit to £399,899, which is carried forward. The results are a sharp disappointment to those people who had looked for a possible dividend on the preference shares. Manufacturing issues, electric and cable alike, are without noticeable change, apart from the falls of 6d. and 1s. 3d. in English Electric ordinary and preference, respectively. Telephone Manufacturing eased off to 6s.

Cables and the Budget.

The Cable group of stocks and shares has no particular feature apart from rises of 5s. in Eastern Extensions and Globe Telegraph and Trust preference. The placidity of prices must not be taken as inferring quietude of business for, in point of fact, the turnover in the quartette during the Stock Exchange account that ends on Thursday this week has been of considerable volume. Pause was given to the buyers by reason of the Budget's advent. Mr. Winston Churchill was expected to make a reference, in his speech, to the possibility of combination between the Government beam system, the submarine cables, and the wireless. Marconis dipped to 60s., rallying to 61s. 3d., and Canadians were vigorously bought by New York, up to 28s., after a previous relapse to 25s. 6d. Apart from the undoubted speculative possibilities they possess, Canadian Marconis look fully valued at anything like 30s. Indo-Europeans remain at 40, the dividend of 10 per cent. being repeated. The profits are down by about £17,000, at £85,900.

Strength in Tramways.

While Underground Electric Railways issues have reacted on Budget apprehensions and profit-taking prior to this week's Stock Exchange settlement, London and Suburban Traction preference came into the limelight. The price ran up from 9s. to 12s. before it underwent a slight reaction. London United Tramways preference strengthened to 10s., the 4 per cent. debenture holding its gain at 57½. Metropolitan Electric Tramways 4½ per cent. debenture stock changed hands the other day at 72½; at the end of March bargains took place in the company's 5 per cent. debenture stock on the basis of 67¾. Of the foreign Utility Stocks, Mexico Tramways bonds are better, and Brazilian Tractions lower. A very active business continues in Hydro-Electrics, price-movements being abrupt and considerable. Budget possibilities cast a shadow over Metropolitans and Districts, it being thought that the anticipated tax on petrol would make inroads into the companies' profits, though this consideration must apply to the Underground Electric Railways, through the London General Omnibus Company, rather than to the railway systems.

American Telephone and Telegraph stock has strengthened to 190¼. British Electric Traction 5 per cent. debenture is better at 98¼. Investment securities of all kinds are in active request. The more speculative issues wavered a trifle on Monday afternoon, lest the Chancellor might have unpleasant surprises to be let loose in his Budget speech.

Share List of Electrical Companies.

	Nom.	Dividend. 1926.	Dividend. 1927.	Price April 23, 1928.	Rise or fall.	Yield. p.c.
Home Electricity Companies.						
Bournemouth and Poole	£1	14†	—	87/6	+7/6	3 3 6
Brompton Ordinary	1	8⅝	—	26/-	—	5 7 8
Charing Cross Ordinary	1	8½	8½	26/6	—	5 5 8
do. do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8⅝	8⅝	26/6	+6d.	5 5 8
City of London	1	10	10	29/6	+1/-	4 15 0
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	33/6xd	—	4 14 10
County of London	1	7½	7½	38/6xd	—	3 18 0
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Edmundsons' Ordinary	1	10	—	67/6	—	2 19 2
do. 7% Pref.	1	7	7	25/6	—	5 9 10
Elec. Supply Corporation	1	11	—	55/-	+2/6	4 0 0
Kensington Ordinary	1	8	8	26/6xd	—	5 5 8
Lancs. Light and Power	1	7½	—	30/-	—	5 0 0
London Electric	1	8½	8½	25/6	—	5 9 10
do. do. 6% Pref.	5	6	6	5½	—	5 8 2
Metropolitan	1	8	9	2½	+½	3 12 0
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6	6½	26/-	—	5 0 0
Newcastle-on-Tyne Ordinary	1	5	6	26/3xd	—	4 11 3
do. 5% Pref.	1	5	5	19/6xd	—	5 2 7
do. 7% Pref.	1	7	7	26/-xd	—	5 7 8
Notting Hill 6% Pref.	10	6	6	10⅜	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	26/-	—	5 4 4
St. James' and Pall Mall	5	8	8	26/6	—	5 5 8
South London	1	8½	8½	26/6xd	—	5 5 8
South Metropolitan Pref.	1	7	7	1¼	—	6 8 0
Urban Ordinary	1	7	—	53/9	+3/9	2 12 2
do. 6% Pref.	1	6	6	1⅛	—	5 6 8
Westminster Ordinary	1	8½	8½	26/-	—	5 7 8
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	22/-	+4½d.	6 16 4
Yorkshire Elec.	1	8	8	33/6	—	4 15 7
Home Rails.						
Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	3	3	70	—2	4 5 8
do. District	,,	3½	4	76½	—1	5 4 7
Underground Electric	£1	1½	5	26/-	—1/6	3 17 6
do. do. Income	Bonds	6	6	124	—6	4 15 9
Telegraphs and Telephones.						
Anglo-Am. Tel. Pref.	Stock	6	6	99½	—	6 0 8
do Def.	,,	1¼	1¼	24½	—	6 1 10
Automatic Telephone	1	10	10	45/-	—	4 9 0
Chili Telephone	5	6	—	7⅞	—	*3 18 8
Eastern Extension	10	10	10	21⅞	+¼	*4 12 0
Eastern Tel. Ord.	Stock	10	10	215½	—	*4 13 0
Globe Tel. and T. Ord.	10	10	10	21⅞	—	*4 12 0
do. do. Pref.	10	6	6	11⅛	+¼	5 7 10
Great Northern Tel.	10	20	—	40	—	5 0 0
Indo-European	25	10	10	40	—	*5 0 0
Marconi	10/-	5	—	61/3	—⅜	1 12 8
Marconi-Marine	1	8½	12½	46/3xd	—1/9	5 8 2
Oriental Telephone Ord.	1	12	—	53 9	—	*4 9 3
United R. Plate Tel.	5	8	8	11⅛	+⅛	*3 11 3
Western Telegraph	10	10	10	20⅞	—¼	*4 16 3
Home and Foreign Trams, &c.						
Anglo-Arg. Trams First Pref.	5	5½	5½	8½	—	7 4 8
do. do. 2nd Pref.	5	6	6	8½	—	7 17 4
do. do. 5% Deb.	Stock	5	5	78½	—	6 7 5
British Electric Traction Def. Ord.	,,	—	—	520	—	... ...
do. do. 8% Pref. Ord.	,,	8	—	124½	—	6 8 6
Brazil Traction	100	6	—	242	—4	*2 6 10
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	95½	—	5 4 9
do. do. Preferred	,,	6½	6½	270	+25	*2 7 2
do. do. Deferred	,,	8	8	310	+20	*2 12 5
do. do. Deb.	,,	4½	4½	82½	+1	5 3 0
London & Sub. Trac. 5% Pref.	1	Nil	Nil	11/-	+1/6	... ...
London United Tram Deb.	Stock	4	4	57½	—	6 19 2
Mexico Trams, 5% Bonds	—	5	5	87	+2	5 15 0
Mexican Light Common	100	Nil	Nil	98½	—	... ...
do. 7% Pref.	100	Nil	7	86	—	8 2 9
do. 1st Bonds	—	5	5	83½	—	5 19 9
Yorkshire (West Riding)	1	Nil	Nil	7/6	—	... ...
Manufacturing Companies.						
Babcock & Wilcox	1	18	15%	£8/9	—⅛	4 7 3
British Aluminium Ord.	1	10	10	45/-	—	*4 9 0
British Elec. Transformer Pref.	1	7	7	19/-	—	7 7 4
British Insulated Ord.	1	15	15	4⅛	—	3 12 8
Brush Ord.	1	10	—	29/-	—	6 17 11
Callenders	1	15	—	4⅜	—	3 8 2
do. 6½% Pref.	1	6½	6½	23/-	—	5 9 5
Crompton Parkinson Pref. Ord.	1	—	—	17/6	—	... ...
Edison-Swan	£/-	10	10	10/-	—	4 0 0
do. 5% Deb.	Stock	5	5	90	—	5 11 0
Electric Construction	1	7½	—	27/-	—	5 11 1
Enfield Cable Pref.	1	7½	7½	26/3	—	5 14 8
English Electric	1	Nil	Nil	7/6	—6d.	... ...
do. do. Pref.	1	3	Nil	11/3	—⅛	... ...
Gen. Elec. Pref.	1	6½	6½	24/-	—	5 8 4
do. Ord.	1	7½	—	36/-	—	4 3 4
Henley	1	25	—	5⅜	—	4 9 0
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	Nil	Nil	13/9	—	... ...
Johnson & Phillips	1	12½	—	53/9	—	4 12 7
Met.-Vickers Ord.	1	8	6	30/-	—	4 0 0
do. Pref.	2	8	8	2⅜	—	6 *1 11
Siemens Ord.	1	7½	—	28 9	—	5 4 4
Telegraph Construction	12	10	10	26½	—	*4 10 11

* Dividends paid free of Income Tax.
† 4% of which was Tax Free.

Our Foreign Electrical Trade.

Electrical Exports and Imports during March, 1928.

THE Board of Trade returns of our exports and imports of electrical goods, apparatus and machinery for March, present a more satisfactory appearance than their predecessors this year. The exports show a substantial increase, being only slightly below the highest monthly figure for 1927—£1,770,978 in November. The most gratifying rise is that in the machinery section. The increase of £85,132 in unenumerated machinery was the highest item, while the section as a whole recorded a rise of £154,244. Another class which exhibited a substantial rise was telegraph and telephone instruments and apparatus, which reached the record figure of £332,270. Unenumerated electrical goods and apparatus, insulated wires and cables, and batteries and accumulators, were all higher than in February. The principal decrease occurred in the case of non-submarine telegraph and telephone wires and cables, which fell by £51,817; the only other fall of any consequence was one of £10,903 in switchboards. Upon comparing the figures with those for the corresponding month of 1927, it will be seen that the bulk of the increase of £207,533 in the total was attributable to the larger exports of telegraph and telephone instruments and apparatus. The machinery section again compares favourably, being £66,828 up on the March, 1927, figures. The other increases of note occurred in the items "unenumerated goods and apparatus" and "non-submarine telegraph and telephone wires and cable." The greatest decreases were recorded by submarine cables and glow lamps.

The import section showed a small rise in the total as compared with the preceding month, but with the exception of a rise of £17,396 in the machinery section, there were no outstanding features. The same may be said with regard to the comparison with March, 1927, except that, in addition to a fairly substantial rise in electrical machinery, there were increased imports of glow lamps and telegraph and telephone instruments and apparatus.

The re-export section showed a rise in both comparisons, the unenumerated classes being the principal contributor.

The totals for the first quarter of the year show that while exports have fallen slightly below the 1927 level, imports have risen to the extent of about two weeks' value.

The following table shows the distribution of our exports of electrical machinery during March, and compares the figures with those for the corresponding month of last year:—

Destination.	March, 1927. £	March, 1928. £	Inc. or dec. £
European countries	62,951	61,457	− 1,494
Japan	23,872	26,109	+ 2,237
South America ...	55,299	84,895	+29,596
South Africa ...	92,908	49,949	−42,959
British India ...	76,356	133,339	+56,983
Australia	153,280	124,653	−28,627
New Zealand ...	35,793	39,531	+ 3,738
Canada	11,071	17,362	+ 6,291
Other countries ...	66,074	107,137	+41,063
Totals ...	£577,604	£644,432	+£66,828

	Exports. Electrical exports for Mar., 1928.	Inc. or dec. as compared with Feb., 1928.	Inc. or dec. as compared with Mar., 1927.	Imports. Electrical imports for Mar., 1928.	Inc. or dec. as compared with Feb., 1928.	Inc. or dec. as compared with Mar., 1927.	Re-Exports. Electrical re-exports for Mar., 1928.	Inc. or dec. as compared with Feb., 1928.	Inc. or dec. as compared with Mar., 1927.
Electrical goods and apparatus (unenumerated)	£239,541	+£37,371	+£22,505	£114,642	+£4,291	−£3,360	£7,080	+£2,414	+£2,661
Insulated wires and cables ...	252,976	+ 13,351	− 7,749	61,705	+ 7,109	− 1,870	1,117	+ 417	+ 600
Glow lamps	38,543	+ 1,559	− 13,912	42,542	− 3,449	+ 14,918	1,029	− 409	− 2,564
Arc lamps and parts	1,070	− 464	− 2,914	2,464	+ 1,042	− 12	88	− 113	− 1,049
Batteries and accumulators ...	102,714	+ 30,537	− 125	42,717	+ 4,682	− 1,659	471	− 603	+ 234
Meters and instruments ...	38,419	+ 638	+ 7,435	22,488	+ 294	− 3,957	404	− 824	+ 76
Carbons	2,383	+ 783	− 2,019	10,372	− 2,735	+ 6,379	259	+ 47	+ 232
Switchboards (not telegraph or telephone)	2,304	− 10,903	− 7,722	328	+ 262	+ 315	100	+ 100	+ 96
Electrical Machinery—									
Electrical machinery (unenumerated)	347,408	+ 85,132	+ 31,826	157,772	+ 17,396	+ 19,044	13,655	+ 5,782	+ 4,870
Railway and tramway motors	70,634	+ 8,674	+ 13,076	—	—	—	—	—	—
Other motors and generators...	226,390	+ 60,433	+ 21,926	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	71,133	− 51,817	+ 15,409	11,422	+ 5,227	+ 6,505	—	—	− 12
Submarine telegraph and telephone cable...	19,109	+ 10,890	− 19,023	—	—	—	—	—	—
Telegraph and telephone instruments and apparatus ...	332,270	+ 66,533	+ 148,820	49,045	+ 862	+ 12,478	2,026	− 1,356	− 1,194
Totals	£1,744,924	+£262,722	+£207,533	£515,497	+ £34,973	+ £48,781	£26,229	+ £5,455	+£3,950
	Exports.			Imports.			Re-Exports.		
Increases and decreases for 1928	− £21,197			+ £263,904			+ £6,143		

A Rapid Conversion to Electric Drive.

An interesting example of a change-over from steam to electric drive recently took place at the paper mills of Messrs. B. S. & W. WHITELEY, LTD., Pool, Nr. Leeds. A few months ago Messrs. Whiteley decided to replace their existing steam engine by electric motors, and the whole of the installation work was entrusted to the Yorkshire Electric Power Co., necessitating the erection of switchgear, motors, and wiring. The company was not given possession of the premises until about noon on the Saturday before Easter, but the gear was installed and the plant in operation by the following Tuesday night. These motors, totalling approximately 450 h.p., entirely replace the existing steam engine, and the whole of the premises are now driven electrically from the supply of the Power Company.

Employment During March.

The April *Ministry of Labour Gazette* states that employment in the engineering industry during March was quiet on the whole, but showed an improvement in most districts as compared with the previous month. The percentage of unemployed in the engineering industry as a whole fell from 8.8 to 8.4. In the electrical engineering section the proportion fell from 4.8 to 4.7 per cent. There was also an improvement in the electrical wiring and contracting industry—from 8.1 to 7.3 per cent. and in the electric cable, wire, and lamp manufacturing group—from 6.1 to 6.0 per cent. The actual number of unemployed in the industries mentioned were:—Engineering, 81,914; electrical engineering, 3,662; electrical wiring and contracting, 1,046; and cable, wire and lamp manufacture, 5,017.

Factors in Industrial Efficiency.

A further Report by the Committee on Industry and Trade.

(*Concluded from page 700.*)

AN important section of the Report is that dealing with industrial fluctuations. A study of the subject has revealed that trade cycles of activity and depression, though definite and continuous, are not uniform in period or magnitude. The evils of these fluctuations are very pronounced, and it has been the Committee's aim to ascertain and recommend methods of diminishing the length of the period and mitigating the effects. It is considered that the causes of trade cycles may be divided into three groups—physical, psychological, and monetary. While the first (which includes such events as earthquakes, floods, and variations in the yield of crops) is outside the scope of human control, the others are susceptible to human action.

The Collection and Employment of Information.

The psychological factor can be affected by every kind of measure which enables men to form more accurate judgments as to the economic situation or induces them to act systematically on these judgments; and the monetary factor by measures destined to control or affect the expansion and contraction of credit and the fluctuations in the commodity price of gold. Prof. Pigou considers that the last two factors have a far greater effect than the physical one.

Under modern conditions the *entrepreneurs* are compelled to make a forecast of the market a long way ahead in founding their programme of production. The uncertainty thus caused is enhanced, and its period lengthened, as soon as the point is reached at which the plant available is insufficient to enable the demand to be met. Plant is ordered during the upward movement, and the manufacturers of plant become congested and are unable to effect deliveries. Producers find themselves with additional machinery after the decline has set in. Movements of this nature are greatly magnified by the contagious nature of confidence and mistrust. The only real remedy for the irrational aberrations of judgment which are the root of the "psychological" factor in trade cycles is the provision of more complete and accurate information and the cultivation of the habit of systematic use of such data. The creation of a new habit of mind will be a slow process, and in the meantime we can only look for practical results to better and more intelligent leadership on the part of that relatively small number of leading financial, commercial and industrial concerns which command the means of obtaining and intelligently using this information.

The Control of Credit.

The monetary factor in trade cycles is bound up with the psychological factor. Upward and downward movements of productive activity are always accompanied by corresponding fluctuations in prices. The predominant influence in these movements is the amount of credit granted by the banks. Within certain limits the action of the banks and other financial institutions with regard to the curtailment or extension of credit may have an effect in checking the rise and, possibly, also the fall of productive activity. Stress is laid on the point that action by the banks will produce quite different effects if applied at the earlier stage of the upward movement, or postponed until a later and more critical stage. The question then arises as to what criteria the competing banks can use to determine the appropriate time for action, and this is where the "psychological" factor, *i.e.*, the power and will of the banker to restrain the expansion of credit, becomes involved with the monetary factor. There is no doubt that the main power of initiative lies with the central bank of issue, the Bank of England. This leads to a consideration of the matters which must control the Bank's decisions, such as the condition of its gold reserve, trade stability, &c., and reference is made to the proposal made at the Genoa Conference in 1922 that joint action should be taken by the leading banks in the various countries.

Official Information and Statistics.

The next section of the Report reviews the existing official means of collecting and disseminating data on industrial and commercial subjects. The activities in this direction of the Board of Trade are first dealt with, and it is considered that, generally speaking, although a number of items have been suppressed since the war, the data now published are in essentials as complete as, and in some respects fuller than, before the war. The Ministry of Labour, the Mines Department, and the Ministry of Transport are then considered; the last includes the Electricity Commissioners' publications. After dealing with the work of the Registrars-General, consideration is given to the activities of the Department of Overseas Trade. It is mentioned that the overseas officers are kept constantly posted on all commercial and industrial developments at home, but in order that their knowledge may be as personal and up-to-date as possible, a system has been adopted of bringing them home, so far as is practicable, in regular rotation, and arranging for them to visit the principal industrial centres. The annual reports of these officers are now prepared specifically for the information and assistance of the commercial community, and are much fuller and more informative than any pre-war reports. The organisation of the department includes tariff, statistical and transport sections, whose function is to answer inquiries by traders on these subjects.

Index of Production.

A section bearing this heading was the Committee's response to the request of the President of the Board of Trade for its views on the subject. The Committee considers it very desirable that percentage figures should be published at suitable intervals by the Board of Trade as indices of the movement of industrial production generally. If practicable separate indices should be published for particular groups of industries provided no objection was raised by those concerned. The Board is urged to give an assurance that the confidential nature of returns relating to individual undertakings will be fully respected, and to publish the results of its inquiries as soon as possible. The trade associations should be asked to collect as much information as possible voluntarily from their members.

Municipal Trading.

The next part of the report deals with municipal gas, electricity, water supply and tramway undertakings. Except to mention that in 1925, 126 municipal gas undertakings out of a total of 317 incurred a net deficiency, we do not propose to deal with the gas supply section. With regard to electricity supply, our reviews of the Commissioners' reports have covered the position very thoroughly so that little remains for us to do but to indicate the Committee's conclusions. Mention is made of the restrictions which hampered the efficient development of electricity supply at its inception, and the history of the industry is outlined up to the Electricity (Supply) Act, 1926. It is shown that the contributions towards rates by municipal undertakings rose from £278,494 in 1921-22 to £760,267 in 1925-26 (107 undertakings), while contributions from the rates decreased from £123,174 to £18,236 (17 undertakings). In spite of this, however, it is stated that there is a growing tendency on the part of many local authorities to apply surpluses to the reduction of charges and to purposes connected with strengthening the financial position of the undertakings rather than to the relief of the rates, a tendency which is assisted by one of the provisions of the latest Act. Although the working expenses of the companies are lower than those of the municipalities, it is shown that their charges are higher, except for power, and that the reduction in prices which took place between 1921-22 and 1925-26 was for all classes of supply greater in the case of the local authorities. It is pointed out that the provision by municipalities for the repayment of loans is more than the equivalent of commercial depreciation, and in so far as it exceeds the latter, it represents the gradual acquisition of the unencumbered ownership of the assets. The majority of municipal undertakings, however, content themselves with providing the annual debt-repayment instalment, leaving replacements to be provided by fresh borrowings when the original loans have been discharged. Brief reference is made to the hire and sale of fittings. Up to the end of 1925-26 a total of £1,077,357 had been expended for apparatus let on hire, of which the local authorities accounted for £844,596, or 78 per cent. It is considered that Section 48 of the 1926 Act will stimulate the municipalities' endeavours in this direction. Tramways and railless trolley undertakings are dealt with, and the conclusion is reached that neither municipal nor company tramway undertakings are so prosperous as they were before the war.

The report concludes with a chapter on dock and harbour administration, with special reference to administration by public trusts. The volume is provided with a very satisfactory index of its contents.

Conditions in Chile.

British Trade Declining in an Expanding Market.

A REPORT upon the industrial and economic situation in Chile has been prepared for the Department of Overseas Trade by Mr. W. F. Vaughan Scott, Commercial Secretary at Santiago (Stationery Office, 3s. 6d. net). In his introduction Mr. Vaughan Scott says that very few people realise to the full the varied and radical changes which the country, its people and its commerce have undergone. The affairs of the country are now being administered in an able manner; this and the reorganisation which has taken place promise great and lasting benefits to the general welfare of the people, besides stability and development to industry and commerce. Investors, manufacturers and traders can look upon Chile with confidence as one which will offer them as good returns as any amongst the most flourishing of Latin-American republics.

Electrical Trade.

One of the branches of import trade which showed marked expansion in 1926 was that of electrical equipment. Chile is a large market for all classes of electrical goods, but the

British share of the trade has gradually declined. In 1921, when the total value of imported electrical apparatus and material was £1,000,000, the United Kingdom supplied 24 per cent., the United States 40 per cent., and Germany 25 per cent. During the next three years the total value was lower, and this country's share remained at about 20 per cent. In 1926 the total rose to £1,375,000, and of this the United States supplied 65 per cent., Germany 20 per cent., and the United Kingdom only 10 per cent. The largest item in an analysis of electrical imports given in the report is electrical machinery (£420,000), of which the United States provided 79 per cent. and Great Britain 6 per cent. The United States accounted for 65 per cent. and the United Kingdom for 8 per cent. of the dynamo and motor imports (£350,000). Our shares of the trade in transmission cables (18 per cent.) and insulated wire (20 per cent.) were better, but only in one instance, telephone apparatus, was the United Kingdom the leading supplier, providing 30 per cent. of the total (£42,000), while the United States' quota was *nil*. The report says that the Chile Telephone Co., Ltd., passed into American hands last year, so that in all probability little of the trade in telephone apparatus will in future go to Great Britain.

The railways (roughly two-thirds Chilean and one-third British) and the extensive tramway systems (British) purchase annually considerable quantities of railway material and smaller amounts of tramway material. The average value of imports during the past three years has been £1,000,000, and Great Britain's share was 20 per cent., the United States again leading with 50 per cent.

Electrical Development.

An official publication, dated April 30th, 1927, gave the number of public electrical utilities in Chile as 140. Only 36 of these are of importance, however, and between them produced 209,802,660 kWh in 1926—or 136 kWh per head of the population. Of the total, 85 per cent. was produced by the Cia. Chilena de Electricidad, Ltda., of Santiago. The new hydro-electric plant of the Cia. Hidro-Electrica "Volcan" was to be put into service early this year. This plant has a capacity of 55,800 h.p., and will transmit power at 11,000 V to Santiago 60 km. away. The total cost of the plant was about £1,000,000. Apart from the public-service companies there are several important industrial plants, the largest of which are the Chile Exploration Co.'s plant at Tocopilla (93,000 kW) and that of the Braden Copper Co., near Sewell (20,857 kW). Proposals have been made for the development of electric power in the Antofagasta district; this would include the supply of cheap power to the nitrate "oficinas" and possibly the electrification of the Antofagasta and Bolivia Railway.

The Chilean section of the Chilean-Transandine Railway has been partly electrified, and the first electric train was put into service in October last. The length of line electrified is 41 km, and three 85-ton Swiss locomotives with rack attachment are employed.* The cost of electrification was £250,000. The Tocopilla Railway, owned by the Anglo-Chilean Nitrate Corporation, has just been electrified to the extent of 27 miles of heavy gradient. A catenary trolley system (1,500 V d.c.) is employed with 60-ton regenerative braking locomotives.

Notes on Trading Methods.

Mr. Vaughan Scott says that readers of the report will draw the conclusion that British manufacturers are yielding their position in Chile's trade to foreign competition. The United States is the most powerful competitor, but not the only one, for Germany, France, Belgium, Italy, Holland, Denmark, Sweden, Spain, Switzerland and Japan are all striving for Chile's custom. The Press and the kinemas are American controlled, and are a potent form of propaganda, but there are other methods of which British manufacturers do not take full advantage. In the Chilean market quality and reputation are relatively of smaller consequence than publicity and price. Mr. Vaughan Scott accuses the British manufacturer of clinging to traditional methods of business in an altered world. There is said to be a need for direct contact between the manufacturer and the market such as exists in the case of foreign competitors.

* Some particulars of the system appeared in our issue of April 13th (p. 649).

Voltage Regulation Control.

Apparatus has been evolved by the Cambridge Instrument Co., Ltd., to control the voltage on feeders within narrow limits.

WHILE for many years automatic voltage regulators or boosters have been regarded as an integral part of most power stations, and much money and time has been devoted to improvements in this connection, the problem of automatic feeder regulation in a.c. networks has not, until recently, received the serious attention it deserves. When it is remembered that by statute the maximum variation in the declared supply pressure is ± 4 per cent., and that without feeder regulation a variation of perhaps as much as 15 per cent. or more in the supply voltage would be possible in some networks, it can be seen that the advantages of automatically controlling the feeder voltage regulation may be very great indeed. It should also be remembered that regulation within small limits not only means satisfied consumers, but also prevents loss of revenue due to reduced voltage. Further, the capital expenditure involved when installing new feeders may be considerably lessened, as the size of the conductor may be limited to that necessary to take care of the normal- and not the peak-load current.

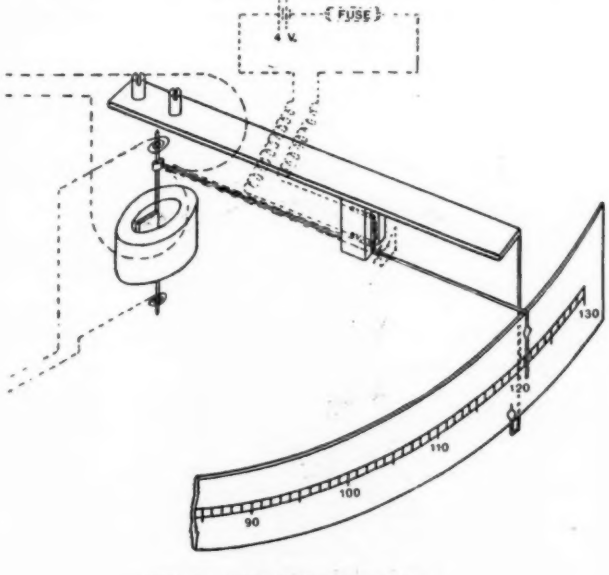


Fig. 1.—The Voltmeter Unit.

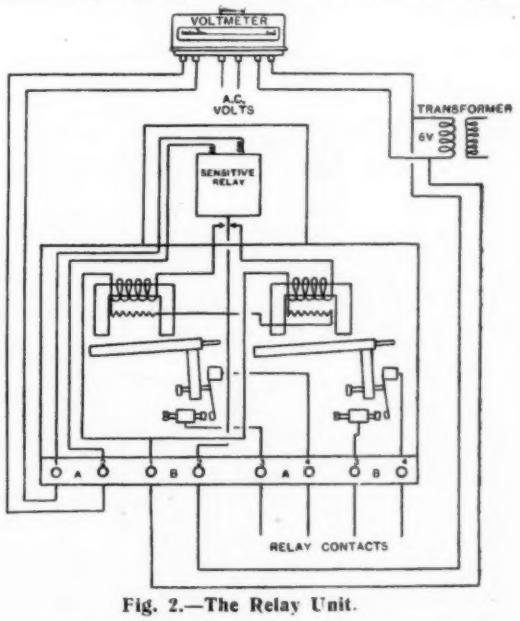


Fig. 2.—The Relay Unit.

The problem of feeder regulation has been solved by several types of apparatus, of which the induction regulator is one of the best known and the most reliable. It was primarily to

work with this type of regulator that the Cambridge automatic voltage control equipment was designed, but it can be adapted to work equally well with other types. With this apparatus, the variation in the feeder pressure is normally limited to ± 2 per cent., so long, of course, as no more than the maximum positive or negative boost of the induction regulator is needed. Where greater sensitivity is required the control can be somewhat closer, but the liability to hunting often renders this undesirable.

The control outfit consists of two parts, a moving-iron voltmeter calibrated to any desired range, and a combination of two Cambridge type II relays and one double-contact sensitive relay. The operation of the outfit can be seen from the accompanying diagrams, figs. 1 and 2. Referring to fig. 1, the pointer N, which is attached to the moving-iron core, carries a differential thermo-couple T_1 T_2, which is connected to the sensitive relay. A small electrically heated coil H is connected to a transformer and mounted on a movable arm B, to which is attached a red flag index F. This is set to the point on the scale indicating the declared pressure, while two pointer stops, P_1 and P_2, which are also attached to the movable arm B, prevent the pointer N from moving away from F more than the scale equivalent of ± 2 per cent. of the declared voltage. When the supply is at normal value, the couples T_1 and T_2 are equidistant from the heater H and, in consequence, no e.m.f. is generated, the sensitive relay, fig. 2, remaining in the "off" position, and the induction regulator, therefore, not running. A negative variation of 2 per cent. in the supply voltage brings the couple T_2 opposite the heater H, and an e.m.f. is therefore generated in the couple, causing one contact of the sensitive relay to be closed, and thereby closing the appropriate type II relay. Similarly, a positive variation of 2 per cent. will bring the couple T_1 opposite the heater, close the other contact of the sensitive relay and, therefore, close the other type II relay. The type II relays are connected so that a positive boost is generated with a drop in the supply pressure and a negative boost when the supply is greater than the rated value. The couple T, or T_2 is prevented by the stops P_1 and P_2 from moving further away from the normal position than 2 per cent. of the rated voltage, *i.e.*, the couple remains opposite the heater while the variation is 2 per cent. or more, thus ensuring that the induction regulator runs continuously until a normal supply figure is obtained. When the supply returns to normal value, the couple is no longer opposite the heater, and no e.m.f. is generated; the sensitive relay therefore opens and stops the induction regulator through the type II relay. An alarm device can be fitted to operate should the heater current be cut off for any reason.

A feature of the sensitive relay is that the normal spring control of the moving coil has been replaced by magnetic control, thus preventing chattering due to vibration on the contacts. The type III relay is capable of taking up to 200 watts

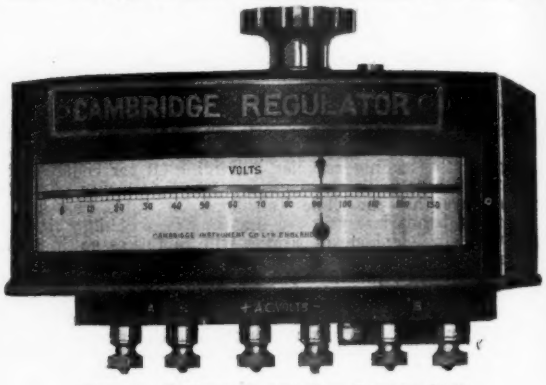


Fig. 3.—Voltage Regulation Control Unit.

on the secondary and has the advantage that with an a.c. supply having a frequency not exceeding 60 cycles, the relay can be connected to the secondary winding provided for the heater circuit, thus avoiding a second tapping on the transformer. The primary circuit of the relay can be operated from the a.c. supply or from a 4-volt accumulator, the current required being 0.13 A.

The apparatus is adaptable for other types of feeder regulation and also for the automatic control of the difference between two voltages in a ring main and other similar problems.

Fig. 3 shows a Cambridge feeder-voltage regulation control unit.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A New Wire Connector.

The Etablissements G. Poulet & Co., of 66, Rue Caumartin, Paris, have recently introduced a new connector, the "Minute," for use in effecting rapid connections of the single galvanised-iron leads used on rural high-pressure power-distribution systems. It consists of a short rod screwed and

Fig. 1.—"High-pressure" Wire Connector.

grooved at both ends. The ends of the conductors lie in the grooves and are securely held by locking nuts. It is claimed that the connector not only ensures perfect contact, but also offers a maximum resistance to slipping or breakage, while connections are made in a minimum of time. Fig. 1 shows the construction of the device and the method of connection.

A Battery Repair Device.

An appliance which has been introduced to facilitate the repair of accumulators is the Atom "Lo-Volt" burner, which is marketed by Messrs. Gerrard & Co., Ltd., 15-19, Great Titchfield Street, London, W.1. The outfit, which is intended primarily for repairing faulty bridges between battery plates, &c., is small, and can be operated from any 6- to 12-volt battery. It consists of two separate leads, one ending in the actual burner with a special carbon bit and the other in a large clip for holding a "lead stick." Each lead has at its other end a clip for connecting to the battery. By making contact with both leads the carbon glows, and its heat is sufficient to melt soft metals such as lead, solder, and so on, so that, it is claimed, a perfectly clean joint can be obtained.

A New Thermostatic Regulator.

A raw heat regulator which has been invented by a Swedish engineer, Trysve Pehrsson, is claimed to eliminate the drawbacks of previous contrivances invented for the same purpose. It is of very simple construction, has only one movable part, is highly sensitive, and can be easily and quickly adjusted for any desired temperature within wide limits. It is, moreover, small in size and inexpensive in operation, and can be used not only in rooms, but also in railway carriages.

Decorated Glass Shades.

We learn that Messrs. Pullars' Electrical Company, Peco Works, Hollingbury Road, Brighton, have developed a method of decorating glassware which, it is claimed, gives most effective results when utilised for electric light shades. By a highly specialised system the glass is permanently tinted and decorated in such a way as to provide a pleasing and mellow light with the minimum loss of candle power. Through-

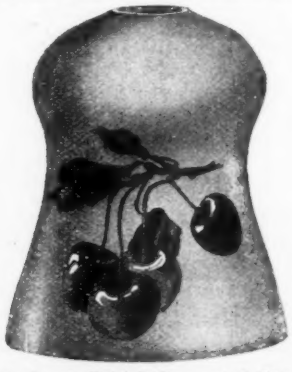


Fig. 2.—A British Decorated Shade.

out the range of designs of the ordinary and inverted shades the finish and price are claimed to compare most favourably with those of the foreign decorated shades, which have during recent years practically monopolised this section of the electrical trade. Fig. 2 shows a shade selected from those available.

A Novel Electric Sign.

A new "day or night" sign, fig. 3, recently introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, has some interesting features. It takes the form of a three-sided or V-shaped box sign which functions during the day by daylight and after dark by artificial illumination, and the lettering or design on the front panel is brilliantly illuminated and uniform, it is claimed, at all times, whether the sign is functioning by normal daylight or artificial lighting. The changing over from daylight illumination to artificial lighting is effected by a device which governs

Fig. 3.—"Day or Night" Sign.

the position of the specially designed interior reflecting mirror and is operated by means of a simple chain-pull attachment. The model illustrated is 27 in. long by 10½ in. wide at the top, and is fitted with two 20-W clear Osram sign-type lamps. This size is suitable for shop windows or showcases, while others, varying in length, are available to meet practically all requirements. The new sign is also claimed to be suitable for all forms of transport vehicles when equipped with 12-V 12-W Osram automobile lamps. Special brackets ensure rigid fixing. It is strongly constructed throughout of ordinary sheet metal, which can be painted to choice, or finished in polished-brass or bronze if desired.

Switch-Oil Purification Equipment.

The use of centrifuges for the purification of switch oil has not been generally adopted in the past, it having been found that the colloidally dispersed carbon found in the oil, which is produced during arcing, cannot be removed effectively by mechanical means. While it has been known that by adding certain chemicals to the oil the carbon particles can be caused to coagulate, so that the larger pieces can be removed by centrifugal force, many processes on these lines have suffered from depreciation of the insulating properties of the oil as the result of the added chemicals. Investigations by the De Laval organisation, which is represented in this country by Messrs. Alfa-Laval Co., Ltd., 34, Grosvenor Road, S.W.1, have resulted, it is claimed, in finding a simple and perfectly safe method of removing the colloidal carbon from the oil. This method embodies the use of a mixture of certain inert clays which give the required result; the mixture is known as De Laval decarbonising powder No. 3. The new process includes the dehydration of the carbonised switch oil, the addition and mixing of the decarbonising clay,

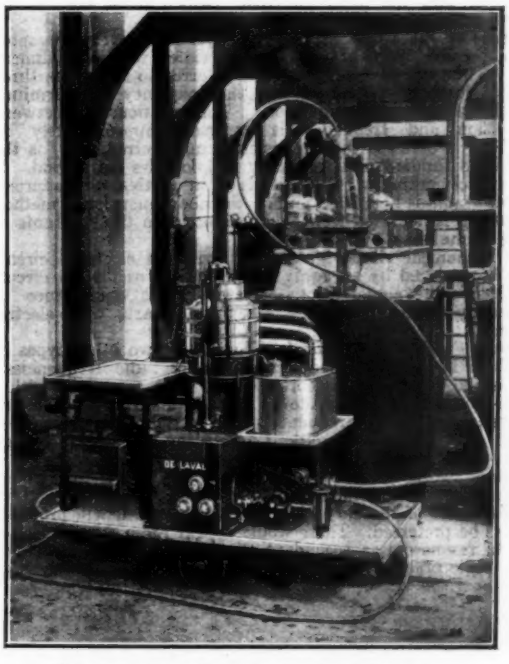


Fig. 4.—Purifying Outfit, in Operation.

and the removal of the clay and carbon by sedimentation and centrifugal purification. The equipment produced for the process includes a special tank with a conical bottom, a motor-driven centrifugal pump, and a De Laval centrifuge unit complete with an electric heater, electrically driven suction and delivery pumps and the necessary control gear. The purifier may be either a portable or a stationary unit.

The De Laval plant is manufactured in three standard sizes with capacities of 110, 220 and 440 gal. per hour. The output of the apparatus is regulated so that the temperature of the oil is maintained at between 60 and 65 deg. C. The oil can be centrifuged an hour after the mixing of the clay. Fig. 4 shows a De Laval portable outfit working in conjunction with a battery of oil switches.

Quartz Radio Resonators.

Some practical applications of the piezo-electric behaviour of crystals, and their use for frequency stabilisation at the Army's Signals Experimental Establishment at Woolwich.

By G. W. N. COBBOLD, M.A., A.M.I.E.E., and A. E. UNDERDOWN, Graduate I.E.E.

(Abstract of paper read before the WIRELESS SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.*)*

THE practical applications of crystalline quartz piezo-electric vibrators are as frequency standards and stabilisers. Other uses have been proposed for them, *e.g.*, as selective couplings between successive valve stages in an amplifier and as "rejectors" whereby interfering signals may be eliminated, but no great progress has been made at present in such directions. A broad distinction may be drawn between the case in which the resonator is used merely to interfere with the oscillations of an electrical circuit and the case in which the resonator is employed as a means of controlling the frequency of such oscillations. The commonest examples of the first case are the "click" method, in which the effect of the resonator is to cause a sudden change of frequency in a valve oscillator, and the "crevasse" method, in which the resonator is employed to absorb power from an oscillatory circuit, with maximum effect at a well-defined critical frequency; in the case of frequency control the resonator is incorporated in a valve circuit, in which retroaction exterior to the valve and apart from that due to the crystal itself may, but need not, be dispensed with.

Shapes and Dimensions.—The shapes commonly employed are the rectangular parallelopiped and the solid cylinder (or disk). The diameters of the latter generally range between 10 and 25 mm., whilst the thickness ranges from about 0.5 mm. to 5 mm. The former are usually either square plates up to about 25 mm. square by anything from about 0.5 mm. to 5 mm. thick, or else bars which are a millimetre or two thick, from 2 to 10 mm. wide, and from about 3 to 60 mm. in length.

Fig. 1 illustrates the manner in which a rectangular bar is normally cut from a block of natural quartz. The surface ABCDEF is at right angles to the optical axis, zz'. The three electrical axes are AD, BE and CF, and in the case illustrated the length of the bar, PS, is at right angles to the electrical axis AD. This perpendicularity to one of the electrical axes is not essential; in fact, certain advantages are claimed for a cut which departs from the perpendicular to a considerable extent. An essential feature is the grinding down of the dimension which determines the natural frequency until the required value is obtained.

When in use the quartz resonator is generally situated between two electrodes: in the case of interference resonators a very appreciable air-gap is generally provided in practice; whereas in the case of resonators used in quartz oscillators the air-gap is usually either extremely small or altogether absent. When there is no air-gap, the crystal must not be clamped or rigidly held between the two electrodes; it is therefore usual either to fit a light spring to press one of the electrodes against the crystal, or else to place the crystal on top of one electrode, and the other electrode (which must not be too heavy) on the top of the crystal.

Modes of Vibration.—Apart from overtones, every resonator has a possible mode of vibration associated with each dimension. Thus one of the bar crystals referred to above has three normal fundamental modes, and the frequency is determined by the appropriate dimension. The relationship between dimension and frequency is expressed approximately by $l=2{,}700\,f$, where l is the dimension in millimetres, and f is the associated fundamental frequency in kilocycles per second. If the corresponding wave-length is λ in metres, the approximate formula is $l=\lambda/110$. When the above-mentioned method of cutting is departed from, changes occur in the constants of these formulæ.

A mechanical vibrator associated with an electrical circuit may be replaced by an equivalent electrical oscillatory circuit coupled to the actual electrical circuit; this equivalence is accurately applicable in the case of a quartz piezo-electric resonator.

Other Frequency Standards.—There are two other types of standard in use for the determination of radio frequencies: one is the elinvar tuning fork, which, when associated with a multi-vibrator, can be made to provide a series of standard points in the band of frequencies used in radio work; the other is the oscillatory electric circuit, consisting of inductance associated with capacity. Although retaining its utility for sub-standard work, the electric circuit is not likely to compete successfully. For national and international standards and for all standards of the very highest order, the fork will probably always be preferred. There would appear to be a great use for quartz resonators as secondary standards, especially in short-wave radio practice where the frequencies are enormously high in comparison with the frequency of a tuning fork.

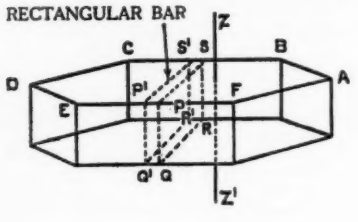


Fig. 1.

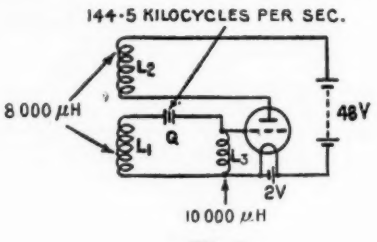


Fig. 2.

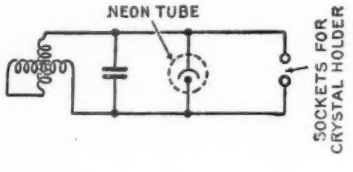


Fig. 3.

Practical Applications.—Of the various applications of the quartz resonator the following are the more important:—

(*a*) Calibrating a series of wavemeters extending in range from 50 m. (6,000 kilocycles per sec.), to 50,000 m. (6 kilocycles per sec.) by means of harmonics from a crystal-controlled oscillator and a supplementary variable oscillator, an accuracy of about 1/10th of 1 per cent. being obtained over the entire range.

(*b*) Demonstrating h.f. longitudinal oscillations of piezo-electric crystal bars, whereby the oscillations may be rendered visible: a quartz-bar resonator and electrodes are mounted in a vacuum tube with a mixture of helium and neon; when an alternating potential difference of the exact frequency of the crystal is applied to the electrodes, a luminous discharge occurs on the surface of the crystal.

(*c*) Measuring frequency: the resonator is connected in parallel with an inductance coil which is in series with the anode of a 3-electrode valve, while the grid and filament are connected to a calibrated oscillator; a valve voltmeter is connected across the crystal, and voltage readings are taken for various values of frequency slightly above and below that of the crystal; the resonant point may be very accurately determined from the curve obtained by plotting the above readings, and is defined by two lines intersecting nearly at right angles.

(*d*) The "crevasse" method of employing quartz resonators for the standardisation of frequency.

(*e*) The production of audio-frequency oscillations: a crystal is cut with a very small step on one of its surfaces in such a way that the thickness of the two halves is slightly different; such a crystal can be made to produce two high-frequency vibrations simultaneously and the beats between these give rise to the desired audio-frequency oscillations.

(*f*) The control of the frequency of transmitting stations.

Methods of Frequency Measurement.—A retroaction circuit was tried, and the results of experiments with it were encouraging, for not only could the air-gap be increased, but the system was "self-starting," *i.e.*, the oscillations were controlled immediately the filament current was switched on. A further development of this circuit, fig. 2, has been adopted as the basis of most of the apparatus described below; with this arrangement the air-gap can be increased to over 1 mm.

The inductance values given are for a crystal of natural frequency (in the longitudinal mode of vibration) of 144.5 kilocycles per sec. (*i.e.*, $\lambda=2{,}075$ m.), the natural frequencies of all three coils being appreciably above that of the crystal.

The fundamental standard of reference used is a multi-vibrator wavemeter (N.P.L. design) embodying a valve-driven elinvar fork vibrating at 1,000 cycles per sec. The apparatus includes a low-frequency multi-vibrator of frequency 1 kilocycle per sec. and a high-frequency multi-vibrator which can be set to 19, 20, or 21 kilocycles per sec.; and from this are obtained high-frequency oscillations at any frequency between 100 and 1,200 kilocycles per sec. which is a multiple of either 19, 20, or 21 kilocycles per sec.

In order to measure the frequency (within the band from 100 to 1,200 kilocycles per sec.) of a high-frequency oscillator, a calibrated acoustic oscillator is used. The multi-vibrator wavemeter is first set to give a frequency in the neighbourhood of that of the high-frequency oscillator, an auxiliary high-frequency oscillator is set to the exact frequency of the multi-vibrator wavemeter, and the frequency of the acoustic oscillator is then matched, by the "double-beat" method, with that of the beat note obtained from the two high-frequency oscillators. The next step is to discover which of the two high frequencies is the greater, and then the value of the unknown frequency can be calculated.

Authors' Applications.—The authors have made considerable use of quartz crystals as "interference resonators" in test work, but no definite instruments have been designed for this purpose. With transmitters they have not been concerned; it is with the use of quartz resonators as frequency standards in association with wavemeters that they have been primarily engaged.

(i) Quartz neon-tube wavemeter.—Consisting of a simple circuit (fig. 3) in which a neon tube is employed as the resonance indicator (some source of moderately powerful oscillations is necessary in order to induce sufficient voltage to cause the neon tube to glow) by interruption of the glow caused by the absorption of energy by the crystal. Fig. 4 illustrates what takes place: if the conductivity of the neon tube is ignored, the curve AEPRD shows the manner in which (in the absence of the resonator) the alternating voltage builds up in the wavemeter. The insertion of the crystal, of natural frequency OM, results in the appearance in the resonance curve of the crevasse PQR, which indicates a maximum absorption of energy by the crystal at the point Q. The line KAD indicates the critical voltage at which a glow occurs in the neon tube incorporated in the wavemeter. In the absence of the crystal the neon tube glows all the time as the frequency of the transmitter is varied from A to D, the maximum intensity occurring at B. When the crystal is in use, the glow suddenly disappears when the frequency of point B is reached, and reappears at the frequency of point C. In practice, BC represents a very minute change of frequency, about 1 in 10,000 perhaps.

A system of this description may be employed to check the calibration of a wavemeter at as many points within its range as there are crystals provided; incidentally the wave-length of a transmitter may thereby be set to the exact frequency of any of the crystals.

A small variometer is connected in series with the earth lead of the transmitter in order to produce very fine adjustment of frequency; this is necessary in view of the fact that the width of the "blot-out" due to the crystal represents a tuning band of only about 30 cycles in the case of a crystal of natural frequency about 300 kilocycles per sec. The following is the procedure adopted: the wavemeter is set, according to its calibration, to the exact value of the crystal and coupled to the transmitter, the latter then being tuned until the neon tube glows. The crystal is plugged in and the wavemeter returned slightly for optimum glow. The transmitter is then re-adjusted until the optimum glow of the neon tube occurs, when the pointer of the variometer in the "earth" lead is approximately at its central position. The variometer is then slowly turned to and fro, during which time the interruption in the glow is looked for. When this has been found and the variometer tuned to the centre of the narrow band throughout which this interruption occurs, the transmitter will be set at the exact frequency of the crystal. The wavemeter is then checked (after removing the crystal) by re-tuning for optimum glow.

(ii) Quartz reference standards in conjunction with a sub-standard.—A quartz oscillator embodying a set of seven quartz resonator bars has been designed for use with a sub-standard wavemeter which covers a range of wave-lengths from 100 to 4,800 m. This instrument is an oscillating valve wavemeter provided with a pair of telephone receivers by means of which

the oscillations of the wavemeter may be heard beating with those of the quartz oscillator. By means of the seven wave-lengths corresponding to the fundamental frequencies of the longitudinal vibrations of the bars, and with the help also of their harmonic derivatives, the wavemeter calibrations may be checked at a large number of points throughout its range.

(iii) Wavemeter giving a series of wave-lengths that are all multiples of 100 metres.—This apparatus has been designed to facilitate the calibration of wavemeters and wireless receivers. It is intended to work in conjunction with a "power oscillator," the wave-length range of which is from 500 to 5,000 m. As the scheme of operation involves the use of harmonics, it is essential that this oscillator should be roughly calibrated to an accuracy, say, of 2 or 3 per cent. If variations of room temperature are ignored, an accuracy in calibration ranging from 0.02 per cent. at 500 m. to 0.2 per cent. at 5,000 m. can be obtained when the "single beat" method is employed; when the "double beat" method is used the accuracy of setting may be greatly increased.

(iv) Instrument giving a series of frequencies that are all multiples of 1,000 kilocycles per sec.—This "crystal multivibrator" has been primarily designed as a reference standard of radio frequencies from 2,000 to 15,000 kilocycles per sec., *i.e.*, from 150 m. to 20 m.; in a later model the wave-length range has been extended down to 15 m. It provides a convenient and accurate means of checking the calibration of c.w. wavemeters (or of adjusting the frequency of an oscillator).

With the exception of a 2-volt accumulator, the whole apparatus, including a 48-volt battery and a pair of telephone receivers, is contained in a single wooden case. The system consists of (*a*) crystal-controlled oscillator, which produces the harmonics; (*b*) selector circuit, which selects and emphasises the desired harmonics and receives the incoming oscillations of the instrument under test; (*c*) detector-amplifier, in which the oscillations are rectified and the resultant beat-note is amplified.

Conclusions.—There is evidence of a wide field of usefulness for the application of quartz resonators in wireless work, particularly when they are employed, primarily as frequency stabilisers, for controlling the frequency of transmitting stations. Their use as frequency standards is, however, by no means insignificant: they are already being made use of by the National Physical Laboratory, at Teddington, and by the Bureau of Standards, of Washington, for the purpose of international comparisons; they have proved to be of considerable value in the laboratory both as standards and as stabilisers, and they appear to be suitable for issue to wireless stations for use as reference standards, where a means of checking wavemeters is required.

In comparison with forks of elinvar steel, quartz resonators possess the advantage that their natural frequencies are well within the portion of the spectrum employed in wireless; whereas, in comparison with standard electrical circuits consisting of inductance associated with capacity, they are more compact and constant, and of lower temperature coefficient.

The temperature coefficient is extremely low; in fact, less than 10 parts in a million per degree F. for longitudinal resonators in which the length is several times as great as either of the other dimensions. As the length is reduced, however, the coefficient increases until it may exceed 30 parts in a million when the three dimensions are all of the same order.

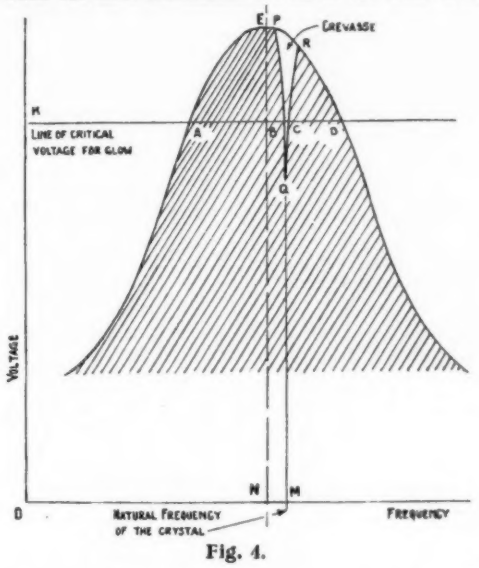


Fig. 4.

With regard to the adjustment of the length of a crystal so as to bring the corresponding frequency as nearly as possible to a specified value, experience indicates that it is not unreasonable to set out to work to within about 1 part in 10,000 if great care is taken and suitable measuring apparatus is available.

The method of mounting the crystals is of considerable importance as the dependance of the frequency upon the dimensions of the air-gap and upon the presence of moisture has been clearly proved: it seems probable that the crystal should be mounted *in vacuo*, and either blocks of fused quartz should be used as distance pieces between the electrodes, or else the air-gap should be dispensed with altogether by pressing one of the electrodes on to the crystal by means of a light spring.

The Institution of Electrical Engineers.

Faraday Medal and Kelvin Lecture.

MR. A. PAGE, president, in opening the meeting of the Institution of Electrical Engineers on April 18th, said that it was of a special nature in the train of events this session, and the presentation of the Faraday Medal to Dr. J. A. Fleming, F.R.S., and the delivery of the Kelvin lecture by Sir Oliver Lodge had attracted what was probably a record attendance. Moreover, they were honoured by the presence of the presidents of the Institutions of Civil and Mechanical Engineers, representatives of other kindred societies, and many visitors, to all of whom he offered a very hearty welcome.

Dr. ALEXANDER RUSSELL said that to an audience of electrical engineers Dr. Fleming needed very little introduction. For many years he had been closely connected with the development of electric lighting, the telephone, and radio communication; in all those branches of applied science he had done invaluable pioneer work. Over 20 years ago his investigations led him to invent the thermionic valve, a device which had revolutionised the practice of radio-telegraphy all over the world and made radio-telephony possible. Dr. Fleming had always been *persona grata* to the Institution: his papers were milestones in the path of progress; he had written 20 scientific treatises, some of which had gone through many editions, and about 100 learned papers, several of which were classics. He had always been in the front rank, pointing out the way, and his genius for experimental research had rarely been equalled, whilst as a teacher of electrical engineering he was unrivalled.

The PRESIDENT explained that in appreciation of world-wide services to electrical science and engineering, a small band of eminent men had been constituted since 1921, and it was then being strengthened by the name of John Ambrose Fleming, F.R.S., to whom the Council thought fit to award the Faraday Medal for 1928. It was nearly 100 years since Faraday made the discovery upon which modern heavy electrical engineering was founded. Dr. Fleming, in his turn, had made a discovery which had led to the great development in weak-current electrical engineering which had been such a notable feature of the past few years. Increased ease of intercommunication could not fail to have a profound effect on international politics, industry, and social intercourse. A good deal might be said on all those subjects, but they had met that evening to honour the man whose work had made those things possible, because it would be agreed that it was the invention by Dr. Fleming of the thermionic valve which had resulted in that advancement being made. In presenting the Medal to Dr. Fleming, the President wished him many years in which to enjoy the esteem and affection which went with the Medal from his fellow members of the Institution.

Dr. J. A. FLEMING, who was given an extremely cordial welcome, said it was not easy to express in a few sentences his deep sense of the honour paid him by the Institution by the award of the Faraday Medal. When the news first reached him it was a great surprise, because he knew that the choice was not limited to members of the Institution, or even to British subjects. All the world was open for choice, and he therefore felt it the greater honour, which he was exceedingly sensible of and deeply grateful to the Institution for. A great deal of the research he had been able to carry out had been done at the Royal Institution in the rooms, and some of it on the very spot, where Faraday made his great discoveries. For many years he was associated with his friend, the late Sir James Dewar, in research upon the electrical and magnetic properties of matter at low temperatures,

and later work was done at low temperature at University College with the assistance of some of his old students. At the Royal Institution the work was done in a little underground back kitchen, where, he believed, Faraday conducted his researches on magnetism, and where he discovered the rotation of the plane of polarised light by a magnetic field. In this connection he recalled that in 3½ years' time, in October, 1931, they would reach the centenary of the date upon which Faraday made those memorable discoveries to which the President had referred, which formed the foundation of the great part of the work of the Institution. Would it not be suitable, therefore, for the Institution, perhaps in conjunction with the Royal Institution, to hold some ceremonies commemorative of those great discoveries and their great discoverer?

The Nineteenth Kelvin Lecture.

Sir OLIVER LODGE, F.R.S., then lectured on "Recent Advances in Physics." Although that title had been given to the lecture, the word "recent" had a relative significance. Anything this century seemed to him to be recent, and he had therefore come to the conclusion that to endeavour to give any idea of the advances in physics which might be regarded as recent from that point of view would be out of the question. The advances in the 20th century had amounted to a revolution, which he did not think was by any means yet over. It had frequently been said that the effect of the revolution had been to abolish the ether of space, but, on the contrary, he held that not only had the ether of space been established, but also that a rational theory of it was beginning to be formed. Then there was the discovery of discontinuity, the indivisible unit of radiation, which had extended its tentacles through all the intricacies of atomic physics in every department. The discontinuity of matter had been discovered long ago, but now the atom had been resolved into electric charges which were localised portions of energy embedded in the ether. That was the idea he wished to emphasise, *viz.*, localisation. The general body of the ether was not localised; there were specks in it which were the first steps towards that great discovery that matter was formed of energy. The constitutional velocity of the ether was commonly called c (he would not call it the velocity of light, although it might be something like it); in essence he regarded it as the constitutional, probably turbulent, rotatory velocity of the ether itself. There were, however, two waves, one of which had a velocity much less than c, and another which had a velocity much greater than c. Dr. Eccles had stated that in the Heaviside layer the waves curled round because they went with a velocity greater than c, which was a most remarkable thing, although it was only one instance. Both were related to the properties of ether and to that absolute velocity c. For all practical purposes c was infinite, and the only true locomotion they knew of was through the ether. The intrinsic energy of matter was only explainable in terms of it.

Sir Oliver Lodge then went into some detail concerning the work of Heaviside and Thomson, and described what he termed the postulate of relativity, all of which, he said, supported the argument that matter was formed of energy. All the theories of Bohr and the numerous other workers in this field, however, were being overhauled, and the end was not yet. Kelvin would have been keenly interested and perturbed by the present state of physics, which was full of hypotheses, and would undoubtedly have seemed to him wild, and certainly of a revolutionary character. The mathematical methods employed were novel and undynamical, and very different from the methods which dominated the 19th century, and were so successful in dealing with the then known properties of matter. There was, however, an enormous amount yet to be understood.

Continuing, Sir Oliver Lodge said that just as we had got used to Bragg, *père et fils*, so must we get used to Thomson, *père et fils;* and Prof. G. Paget Thomson, in the *Proceedings* of the Royal Society for February this year, had put forward a theory which he regarded as a very great discovery, *viz.*, that particles had to travel at high speed before they became waves, or anything like waves, and that the wave length could be calculated from the potential drop which propelled the particles. That theory had been justified by experiments. The result of the experiments and the theory agreed: the particle was the one extreme and light was the other, and on this theory it was shown how the two were united. There was more to be discovered about ordinary radiation, but he conceived that in this case there was a radiation of a new type; it was a momentous discovery, confirmatory of the theory of wave mechanics, which was the beginning of the present theory of the ether.

Sir Oliver Lodge read his lecture from a large amount of prepared matter, only mentioning a small portion of what he had written for subsequent publication. In a general summing up, he said that they had never known for certain that the electron was a sphere. They knew that all heavenly bodies were spheres, because a big thing must be a sphere; if it were a cubical body its corners would fall in under gravity. An electron might be a ring, or a vortex, or all sorts of things: when it was moving quickly it was a little series of stationary waves, and the quicker it was moving the more the wave aspect of it was emphasised. His own postulate was that the electron was hollow; at any rate, he regarded that as the possible structure. The ether was exerting a great pressure, and it might be asked how could a hollow sustain itself under this pressure? His answer was because of its electric charge. The hollow electron must be charged, so that the tension and the pressure balanced. The questions might then be asked: would there be equilibrium, and what would be the size of the sphere which would sustain the pressure? Would it be a large or a small sphere? To get stable equilibrium there must be potential energy, and this and other matters had been explained to some extent.

In other directions there had been revolutions, but the mathematical investigators were not only getting out of our depth, they were soaring up to the clouds, and it was only possible for others to follow their progress and find out where they were when they occasionally dropped a bomb to earth. Then we sat up and attended; they were not destructive bombs, however, although they might be perturbing. When they were opened they were found to contain seeds which, when they took root, flourished exceedingly. All through the 20th century such bombs had been dropped with such results that it was only possible to admire the brilliance of the explorers and wonder at their achievements in the air.

Dr. W. H. ECCLES, proposing a hearty vote of thanks to Sir Oliver Lodge, said there was no need for him to emphasise that electrical engineering and the electrical profession owed their being to abstract physics more than any other branch of applied science or engineering. He recalled that Faraday himself produced a revolution in abstract physics, and on that revolution the heavy-current electrical industry was founded. Maxwell, Hertz and Lodge had also produced another revolution which had given the great branch of electrical communication. Other revolutions had led to radioactivity and X-rays, and there was little doubt that still further revolutions would lead to industries of considerable importance. The new revolution to which Sir Oliver Lodge had referred as being due to Prof. Thomson, would no doubt lead to new discoveries and perhaps new industries; it was certain that the electrical industry would feel the effects first and feel them most. Indeed, there was little doubt that one revolution would be succeeded by another as time went on, and Sir Oliver, in his usual charming manner, had traced what had been taking place, and indicated what might possibly happen in certain directions in the future.

Mr. W. M. MORDEY, who seconded the motion, said "although, at any rate speaking for himself, it might have been impossible to follow clearly all that Sir Oliver Lodge had said, yet it was always very interesting to hear Sir Oliver, because of his charm of manner as a lecturer. Even if one did not follow the heights of thought of the lecturer, one appreciated that a great thinking machine was at work, which was a great attraction.

The vote of thanks was carried enthusiastically, and Sir Oliver Lodge briefly acknowledged it. What he had been dealing with would have to be expanded into a book, but he felt that they were living in a very interesting period, and he sometimes wished he were young enough to take a full and vigorous part in it instead only of admiring what other people were doing.

Chlorine and Caustic Soda Plant.

For the electrochemical production of chlorine and caustic soda a new type of cell, the Vorce cell, has been developed, and is the basis of an installation at the works of Westvaco Chlorine Products, Inc., at South Charleston, W. Va., some particulars of which are given in an article on "Worth-while Economics in Producing Chlorine and Caustic Soda," by Mr. Sidney D. Kirkpatrick, in the March issue of *Chemical and Metallurgical Engineering*. The new cell is cylindrical in shape, and measures 26 in. in diameter and 42 in. in height. The cathode pot is about 22 in. in diameter, and the steel container tank is 38 in. high. There are 24 Acheson graphite anodes about 2 in. square, the ends of which extend through the upper (dome) of three concrete rings on which the cell is built up. Experience has demonstrated that with proper care the anodes will last about a year. The brine is fed to the cell from a receiving tank which provides a constant head of 14 in. An ingenious glass device, which is a modification of that developed by Pritchard at the plant of the United Alkali Co.'s works in England, controls the actual in-flow of the brine. Caustic liquor discharges from the cathode pot through a small cup-shaped device which breaks it into small drops, and it is conveyed then to the evaporator house. The chlorine gas is withdrawn from the dome of the cell through a glass connection, and, after passing through cooling and drying apparatus, part is used in the works for the production of chlorine products, and the remainder is pumped to the chlorine liquefying building near by. Hydrogen gas collected from the cell outlets is piped to plant for consumption in chemical manufacture. When completed, the installation of 2,240 cells will occupy a floor space of 205 ft. by 160 ft., the cells being arranged in 32 series of 70 cells each. The cells are operated at about 1,000 A and 250 V for each series. Test results show a production of 0.859 lb. of caustic per kWh and 0.793 lb. of chlorine for the same consumption.

The Overhead Lines Association.

Suggested Standardisation of Wayleave Forms.

AT the meeting of the Association held in the Institution of Electrical Engineers, London, on Wednesday, April 18th, Mr. R. Borlase Matthews presiding, it was decided to abandon the meeting previously arranged for June, on account of the holding of the I.M.E.A. Conference and the Institution of Electrical Engineers' Summer Meeting. It was also decided to hold the July meeting at Mr. Borlase Matthews's electric farm at Greater Felcourt.

Wayleave Agreements.

Mr. W. C. BEXON (Ayrshire Electricity Board) then read a paper entitled "How far Wayleave Notice and/or Agreement Forms can be Standardised for Great Britain with Advantage to all Parties Concerned." He pointed out that the powers of granting wayleaves fell upon the Ministry of Transport, but at present he contended that the powers of Clause 22 of the Electricity Supply Act, 1919, which governed the matter, were not wide enough. Moreover, the Electricity Commissioners' annual reports showed that wayleave rentals varied from 10s. 6d. to 1s. for a standard wooden pole, but there could not be such a big difference in the value of land as to warrant that difference in wayleave rentals. Recently, rather than submit the matter to the Minister of Transport the question of annual wayleave rentals in the author's area in particular cases had been submitted to an arbiter, who was a qualified land valuer, and the rental fixed was 2s. 9d. per "A" pole. It was the usual custom in Scotland for a field to be in crop for four years and in grass for three years, and the 2s. 9d. rental was based on this rotation.

Too often, said Mr. Bexon, owners, or tenants, were under the impression that an electricity supply undertaking was a large profit-making concern, but they failed to appreciate that in the case of a municipal undertaking they were really shareholders, whilst in the case of a company undertaking ease of facilities for wayleaves resulted in electricity being supplied much more cheaply.

After pointing out the general scope of Clause 22 of the Electricity Supply Act, 1919, which gave the Minister of Transport certain powers, Mr. Bexon complained that it did not give the Minister of Transport any powers to authorise the placing of overhead lines over gardens, or pleasure grounds. Already a certain town council in Scotland had refused to give permission to the Central Electricity Board to erect its "grid" transmission lines over a new housing scheme site and in the present position the Board was helpless; the result was that that particular line would have to be surveyed anew, involving increased capital expenditure. He himself had encountered similar obstacles with regard to private gardens, and certain householders were, as a consequence, unable to obtain any electricity; similarly, difficulties were being encountered with the railway companies. Summarising the whole position, Mr. Bexon said that the effect of Clause 22 of the Act of 1919 only gave the Minister of Transport powers as regarded cultivated lands, but even then it was possible for the wayleave rental often to be exorbitant. Whilst electricity supply authorities were in this difficult position, the Post Office had every protection, but he contended that electricity supply was more important than either telephones or telegraphs: yet the Post Office works were at present a formidable obstruction to the electricity supply industry. After recounting some of the objections to the position of the Post Office, Mr. Bexon quoted a case of a railway company which had given permission for a transmission line to be erected parallel with the railway, yet the Post Office frivolously objected. There were 14 railway telegraph lines intermingled with which on the same poles was a pair of Post Office telegraph wires, and the Post Office appeared to think that should one of the power wires fall it would select the Post Office wires to come into contact with.

He had recently received a printed wayleave agreement from a railway company with regard to permission to lay an underground cable under a railway. The rental asked was 5s. per annum, but he was also asked to pay two guineas, plus 2s. 6d. stamp duty, for the agreement which was in a form which could be printed at the rate of 1,000 for a £1. He also complained that in negotiating wayleave agreements, the electricity supply authority had been compelled to pay the legal expenses of the other side, varying from £10 to £25, all of which things, he argued proved conclusively that the State must immediately do something to assist in giving better facilities, as Section 2 of the Act of 1919 appeared to be of little use in that direction.

It was, therefore, suggested that the Government should immediately bring in a new Bill dealing with wayleaves, and embodying the following:—

(*a*) Undertakers to have powers to erect overhead lines, but in case of dispute the matter to be referred to a local arbiter.

(*b*) Provisions for safeguarding the undertakers against frivolous objections.

(*c*) Powers to grant authorised undertakings rights to erect overhead lines over, or lay underground cables under, railways or canals, &c., without the present cumbersome procedure.

(*d*) To give powers to electricity undertakings to attach any easements to buildings. Under the Police Burgh (Scotland) Act, 1892, a local authority had powers to erect public street lamps on any building. Electricity supply authorities should have the same facilities. An extract from Clause 99, Part IV, Police Administration, of the above Act, read as follows:—

> "... and the Commissioners are hereby authorised to order the lamp irons, lamp-posts, and lamps to be fixed, either upon the sides of the causeways, streets, and roads, or upon the kerbstones of the pavements or footways, or at or upon the rails, or in or upon the walls of buildings on the sides of the streets as they shall think proper, without being liable to any claim for compensation thereanent."

(*e*) With regard to the Post Office regulations, electricity undertakings should have the same facilities as the Post Office in connection with the erection of overhead lines. Clauses should be inserted in the new Bill to give those conditions, and whichever utility was the most important should have preference.

As regarded the position of landlord and tenant concerning wayleaves, the author expressed the view that the tenant was entitled to more compensation than the landlord, because any obstruction placed on the land was a loss to the tenant and not to the landlord. It had been argued that if the landlord was paid a rental it should be left to him to compensate the tenant, but his own view was that both owner and occupier were entitled to some wayleave rental; working on this basis he had been successful in many instances in getting wayleaves without difficulty. It was more economical to the undertaking to give a fixed wayleave rental to the farmer each year, which not only covered the loss due to the pole being erected, but also the losses in repairing and maintaining the lines and, of course, undertaking to pay compensation for any damage done to the crops during the erection of the transmission line, and making good as far as reasonable any damage or injury occasioned by the transmission lines. His standard wayleave agreement, which had been accepted by both owners and tenants with regard to some 200 route miles of overhead lines, provided for an annual wayleave rental of 1s. per pole per annum in grass, 1s. 6d. per pole per annum in corn, and 2s. 6d. per pole per annum in green crops to the farmer, and 1s. per pole per annum to the landlord. In some cases there had been objections, but on arbitration the average price fixed had not been very much more than these figures.

Where there were no poles on the railway companies' property, they were not entitled to any wayleave rentals, but the 1s. per 100 yards of underground cable per annum charged by some railway companies was, in his opinion, reasonable.

As to the Post Office, no question of wayleave rentals arose, but the Association should endeavour to get into touch with the Post Office with a view to coming to some arrangement for working more in harmony. Finally, Mr. Bexon referred to the fact that the I.M.E.A. had a standard wayleave agreement running into 12 pages, but his own view was that such agreements should be kept as simple as possible, and that was the object aimed at in his own form.

Discussion in London.

The PRESIDENT said that in accordance with the usual practice of the Association it was the intention to draw up some concrete proposals for submission to the Electricity Commissioners, who had advised the Association in advance that they would welcome any assistance in the matter.

Capt. HENDERSON (Central Land Owners' Association) said that the members of his organisation were in sympathy with the objects of the Overhead Lines Association, because they felt that a cheap supply of electricity would stop the rush of the population from the country to the towns. At the same time, landowners were compelled to look at the matter from the £ s. d. point of view, and consider to what extent the placing of poles across their property would depreciate it, having in view the possible sale of the property, because there was little doubt that a prospective purchaser would argue that the existence of such poles did seriously depreciate the value. He did not think that difficulties between landlord and tenant would arise so much in the future, because an increasing percentage of farms in the country was owned by the farmers themselves.

The HON. SECRETARY read a letter from the I.M.E.A., which had been invited to send a representative to the meeting, stating that the Council of the I.M.E.A. did not at the moment appreciate the necessity for any revision of its standard wayleave agreement, and that when such a course appeared advisable to it, the matter would be dealt with in the ordinary way, possibly in conjunction with other associations interested.

Mr. BASIL LIPSCOMB (Land Agents Society) said that his organisation would certainly welcome any steps taken by the

Overhead Lines Association to simplify the procedure as regarded wayleaves. Members of his Society in the past had had no difficulty whatever in coming to terms with power companies in the North of England, although he admitted that those particular lines were not for rural electrification. So far as the latter was concerned, a new position had arisen, and landowners were not quite sure what might happen; therefore they had to proceed carefully. On the general question, landowners were sympathetic because they appreciated the advantages of cheap electricity on farms, although it would take some time, he feared, to convince the average farmer that he must scrap his existing machinery and use electricity. He believed it would be perfectly hopeless to attempt to fix any flat rate, either for arable land or grass land, to apply to the whole country; each case must be negotiated on its merits. His view was that it was very much wiser to negotiate with the landlord than the tenant, leaving the landlord to make the necessary arrangements with the tenants. He regarded side-stays as more dangerous in fields than poles and that was a matter which needed consideration; valuable cattle had been injured by side-stays. In dealing with one large estate, wayleaves over which were negotiated over 20 years ago, the figure of 3s. per fixture was agreed upon and still held good. The safe angle in going round a field was another matter of importance, and another question was the right of a power company to refuse to give a supply to a farm over which its lines passed, as there had been instances of that.

Mr. W. FENNELL suggested that the author was wrong in saying that there were no powers to carry lines over private gardens. He had several such instances in his area by agreement with the owners. As to the suggestion that land was depreciated by the existence of poles, there was an instance in his area in which the owner bragged (after negotiating with the power company for a rental of £1 per pole, but accepting 1s. eventually) that the value of his land had been increased by £100, because he could sell it for residential purposes more readily owing to a supply of electricity being available. He agreed that the negotiations should be with the owner and not the tenant, and said that his greatest difficulty had been with small land owners who were puffed up with an immense sense of their importance; the difficulties were not nearly so great when dealing with large estates. The question of giving a supply on a farm upon which transmission poles were placed was a difficult matter, because it was not appreciated that the lines were high-voltage ones, and that to give a supply involved considerable expenditure in transforming apparatus. Therefore, such supplies could only be given on the basis of dealing with an area, and it was not reasonable for a farmer to be able to demand a supply to his farm merely because the poles were on his property. Side-stays were admittedly a danger, and he himself had had to pay for the loss of three cows. At the same time side-stays were only necessary when the line had to be zig-zagged owing to the farmer compelling the supply authority to go round instead of across, so that that danger could be minimised. He deprecated those matters being handled through lawyers owing to the unnecessary expense entailed, and therefore supported the proposals for a simplified standard agreement form to serve as a basis. His method of procedure was to give notice to the parties concerned in the form provided by the Electricity Acts. As regarded agreements with the railway companies, in one case he paid two guineas for an agreement and two guineas a year for crossing a mineral line, but the next case of the same kind he took to the Commissioners and got it for 1s. a year, and nothing for the agreement. He believed that certain negotiations were going on in this respect and the Association ought to take a hand in them.

Major T. RICH said that rural electrification would only be possible in this country when lines at 11,000 volts could be constructed for something like £250 per mile. That would involve a considerable modification in the regulations at present in force in this country as regarded concrete poles, the use of which would be a considerable factor in reducing the cost of construction if they proceed on the lines adopted on the Continent in this respect; there were 800,000 concrete posts for agricultural transmission purposes in France alone.

Mr. GAUVAIN said that in New Zealand the wayleave agreement was based on the understanding that power should be available to the property through which the overhead line passed.

Mr. LIPSCOMB said that in one case he charged 1d. per yard of wayleave, which worked out at about £7 6s. 10d. per mile with poles 40 yards apart. If the distance between the poles was double the charge per mile would be a mere nothing, compared with the £250 per mile mentioned by Major Rich.

Mr. W. C. BEXON, replying to the discussion, said it was unreasonable to ask a supply authority to tap a high-voltage line, above 11,000 volts at any rate, for supplying a particular farm, because the poles were on the property, as the capital cost would be very much more than the revenue. He regarded Mr. Lipscomb's figure of 3s. per fixture as high. (Mr. LIPSCOMB said it was in respect of lines carrying large commercial supplies, and not for rural distribution.) As regarded carrying lines over private gardens, he had been compelled by the owner to take one down, having put it up without his consent, and the Electricity Commissioners had informed him that he had no compulsory powers.

Mr. W. FENNELL said that, in his case, the lines were erected with the consent of the owners after the owners had been informed that if permission was not given to carry them over the gardens, the poles would be put along the fronts of the houses.

Mr. BEXON, continuing, said that in Scotland various power companies were paying varying rates, and this fact was known to the farmers, who were insisting upon the higher rates when new wayleaves were being negotiated. The Central Electricity Board had at first been able to negotiate wayleaves for some of its towers, which were 18 ft. square at the base, for a rental of 5s., but now it would not get them for £5; thus, there was a great necessity for a standard wayleave agreement.

The PRESIDENT said that information was being collected on the whole subject and an analysis of the best practice in the country would be prepared and forwarded to the Electricity Commissioners.

[The Overhead Lines Association informs us that the United States "National Electrical Safety Code," Fourth Edition, is now available to readers in the Library of the Institution of Electrical Engineers; it includes the "Safety Rules for the Installation and Maintenance of Electrical Supply and Communication Lines" issued by the Bureau of Standards under the ægis of the U.S. Department of Commerce, a publication which was fully reviewed in our issue of November 11th, 1927, p. 810, by Mr. W. T. Taylor, M.Inst.C.E., and which contains a mass of valuable information regarding overhead line construction.

We learn from the Electricity Commissioners that the new set of Overhead Lines Regulations which they have had in preparation is about to be published, and will in fact appear before this issue is in the hands of our readers.—EDS. ELEC. REV.]

The Building Trades Exhibition.

A Review of the Electrical Features of this Year's Show at Olympia.

APART from wood-working machinery and builders' plant which was motor driven for demonstration purposes, electrical exhibits were not in evidence at the Building Trades Exhibition, Olympia, London (April 13th to 16th). The Cable Makers' Association's series of show cases illustrated the several types of cable used for power and lighting purposes and some of the more ordinary kinds of underground telephone cable. Lift makers did not, however, neglect their opportunity, and amongst those represented may be mentioned Messrs. MARRYAT & SCOTT, LTD., on whose stand was a goods lift, built to a reduced scale, driven by "Leveltric" gear and push-button controlled. A new universal utility lift is designed to raise 40 lb. at 80 f.p.m. Push-button controlled and fitted with all safety features, it can be packed and delivered to any address in the United Kingdom within 14 days, for connection to any a.c. or d.c. system; it is supplied complete in every respect, including self-contained shaft wiring and all the necessary apparatus for its erection in a self-supporting tower by unskilled labour. MEDWAY'S (SAFETY LIFT) CO., LTD., and WAYGOOD OTIS, LTD., also exhibited lifts.

WM. WADSWORTH & SONS, LTD., showed a turn lift designed mainly for garage work (see ELEC. REV., September 9th, 1927, p. 442), and also a new two-speed a.c. lift for which various advantages are claimed.

H. ARNAULT, LTD., made a feature of panels of engraved glass; also electric light fittings made of such panels, as well as of enamelled and moulded glass. The deep engraving results in striking lighting effects, and the stand was as a whole very suggestive of what can be done in this direction.

W. H. WILCOX & CO., LTD., showed "Penberthy" automatic cellar or sump drainers, which are electrically operated and cease to act when the accumulation of water has been disposed of.

EASIWORK, LTD., displayed the "Croco" electric ventilator, the fan of which is driven by a reversible motor; it will fit into any sash window, or can be built into a wall, and is intended to be used in kitchens and other places that are difficult to ventilate. The "Barnet" electric refrigerator was also shown.

FRIGIDAIRE, LTD., exhibited automatic electric and other refrigerators.

ELECTROLUX, LTD., had electric refrigerators, vacuum cleaners, floor polishers, and water softeners on view.

BRITISH QUAIN SUNLIGHT, LTD., showed ultra-violet and infra-red ray lamps for use in the home, including a model that can be employed as a heating radiator when not in use for producing light.

YOUNG, OSMOND & YOUNG, LTD., showed "Unity" towel rails and tubular electric skirting heaters, which are claimed to be specially designed for large buildings.

Other exhibitors included MESSRS. H. C. SLINGSBY (electric battery trucks), BUTTERS BROS. & CO. (electric worm-geared winch and model of electric derrick crane), STAINES KITCHEN EQUIPMENT CO., LTD. (electrically-driven crockery washer), KANGO CO., LTD. (electro-mechanical hammers), and the NORTH BRITISH RUBBER CO., LTD. (ebonite for electrical work).

The next exhibition is to be held in 1930.

Correspondence.

Correspondents should forward their communications as early as possible. No letter can be published unless we have the writer's name and address in our possession.

Domestic Water Heating.

I am flattered that my short note, which you published in your issue of March 30th, has called forth your editorial comments and aroused interest.

I forgot that the expression "cheap" was anathema in the profession, although it was intended in the economical sense. For domestic purposes I have found from my own experience for some years that an electric washing machine, electric irons, electric vacuum cleaners, and electric light even at 2¾d., 3¾d., and 8d. per unit for heating, power, and lighting respectively, are economically cheap in the ordinary domestic household. However, for general heating it is my experience that gas fires for rooms and a coke and rubbish stove for hot water and central heating are the cheapest at present for the average householder, whom mass production of electricity hopes to serve.

I have not forgotten the cost of cleaning, painting, redecoration, and house labour, but cannot afford to be extravagant in these strenuous days of high taxation. Get domestic heating costs down to somewhere near a competitive rate with gas and it will develop rapidly, but even at a penny per unit it is still uneconomical to the average householder. The points of the Editorial are indisputable, but in this case they do not fit as to shoes or beef. On lighting and power we agree. Look at the above unit costs, and this is not an isolated case, and even though I may have taken bare cost at 5d. per day for coke, see what margin you have between this and electric domestic water heating to cover the extras indicated by Mr. R. J. Hebbert. I have no doubt that, when we see unit prices all over the country down to 0.5–0.75d. per unit, electrification in the house will become essentially a habit and that, it is hoped, will be brought about by its real cheapness. We have been promised wonders on electrification costs for the future. Here's hoping!

Edward Dixon,
Director, OLLIVER & ADDIS, LTD.

Margate, *April 17th*, 1928.

Unfair Trading.

I am glad to see from your issue of April 13th that "Contractor No. 2" urges the promptest, and perhaps most effective, method of dealing with the above evil.

As branch manager of a wholesale firm which has enjoyed trade confidence for a quarter of a century, I frequently have to listen to the galling experiences of my customers. Trade associations do their best, sometimes on complaints that are stronger in aggrieved feelings than those solid facts, without which no responsible committee can take action involving the reputation of any firm.

The periodic meetings and necessary routine of such associations involve time, but the complaining party can always do his part promptly.

Let him make sure of his facts, and transfer his business to a firm he can trust. Strange to say, this frequently involves a temporary sacrifice.

The firm which goes behind the retailers' back is generally the firm which offers to retailers those illicit discounts which are the bane of legitimate wholesale trading. Such a firm breaks faith with suppliers and customers in equal disregard of business morality, and relies on the insufficient profit obtained one way being made up by increased sales. How these sales are made matters little. Let the contractor set the "buckshee discount" merchant about his business, support only firms of good report, and thus do that individual bit towards clean business which we all desire.

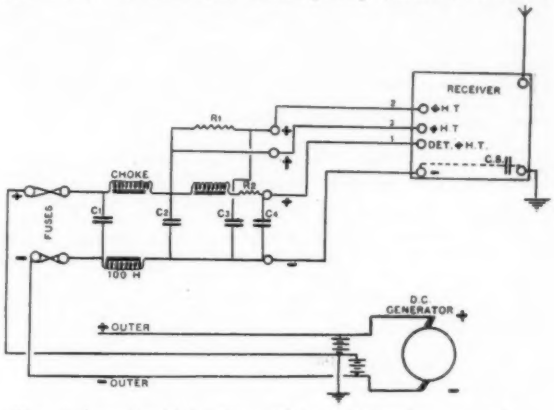
As "Contractor No. 2" kindly says, there are a few—yes, quite a few—of us carrying on our businesses on proper lines, as we have always done, and it grieves us not a little to know the reason why we cannot sell lamps and other proprietary lines to some of those whom we pledged ourselves long ago to support.

West Riding.

April 21st, 1928.

Battery Eliminators.

In the last three issues of the ELECTRICAL REVIEW I have been interested in the discussion of h.t. eliminators for wireless receivers on d.c. mains, and the difficulty in obtaining current without hum—particularly on d.c. three-wire systems, owing to the neutral being earthed. It may interest readers to know that any (shall we say?) disturbances of this nature can be entirely overcome if eliminators are constructed on the lines indicated by the accompanying diagram, and care is taken to use only first-class fixed condensers and wiring. The latter should invariably be v.i.r. 3/.029 or 3/.036, having an insulation resistance of not less than from 600 to 2,500 megohms, and the same care should be taken in wiring as is taken in wiring up receivers themselves. The writer has one of these made by himself, and, after many experiments, owing to a background of hum, partly due to some battery-charging motor-generators being on the same section, and possibly to soms leakages outside, has found it to be all that can be desired. There is no background whatever, even between the items; it is just as good as any battery, and far less expensive in upkeep. With regard to safety, constructors should see that the live terminals are spaced well apart and well insulated, and *inside* the eliminator cabinet; they should also use a



The chokes should be from 50 to 100 henries; R_1 and R_2, according to voltage on mains and required voltage on receiver; R_2 must be fairly high, anything from 30,000 to 50,000 ohms; C_1, C_2, C_3, 4 mfd. each; C_4, 2 mfd.; C_5, .01 to 3 mfd. will be satisfactory.

Radio Battery Eliminator Diagram.

switch plug (combined) or a switch and plug, taking care to switch off when the set is not in use. If these precautions are taken, this apparatus will be as safe as any other well-designed domestic apparatus.

W. H. Smith.

Frinton-on-Sea, *April 16th*, 1928.

Single-pole Fuse Boards.

Will some of your readers enlighten me on the following points—assuming that the supply is single-phase, one side being the neutral of the transformer supply, or, in other words, earthed at the sub-station:—

(1) Is it in order and safe to use single-pole distribution fuse-boards on premises wired on the above system?
(2) Is it in order to use a single-pole main switch or fuse at the entrance of the house supply?

Your readers' assistance will be appreciated.

Electron.

April 21st, 1928.

Parliamentary News.

[By Our Special Parliamentary Reporter.]

Electricity in Agriculture.

On April 19th Sir PHILIP DAWSON asked the Minister of Agriculture whether his attention had been drawn to the development which had taken place in the last 10 years in the use of electricity for farming purposes in Sweden and to the informative literature dealing with that subject issued by the Swedish Government departments for the benefit of the community; and whether he would take steps to make this information available to the British farmer.

Mr. GUINNESS said he assumed his hon. friend referred to a method of heating the soil by electricity which had been advocated in Sweden. Experiments with that method had been conducted for the last two years at the Cheshunt experimental station, and were still in progress. While it would be premature to express a final opinion, the director of the station reported that so far there was no indication that the method could be applied economically in this country. A conference, summoned by the Electricity Commissioners, was at present considering the whole question of rural electrification in this country. A large amount of information from Sweden, as well as from other countries, was before the conference. He was awaiting the report of the conference before deciding what further steps to take in the way of providing advice to farmers on the application of electricity to agriculture.

On April 23rd, Sir PHILIP DAWSON asked the Minister of Transport whether his attention had been called to the large and growing use of electricity in farming and in market gardening in Sweden, and to the fact that this had been rendered possible by the use of a simple and cheaply constructed overhead distribution system, and to the fact that current could be sold for agricultural purposes as cheaply in Great Britain as in Sweden provided the requirements of such authorities as the Postmaster-General, the Electricity Commissioners, local authorities, and other public bodies, such as the Thames Con-

servancy, were modified, and unnecessary delays in the granting of wayleaves were put a stop to; and what steps he was taking to alter the existing conditions so as to make the erection of overhead distributing systems commercially possible in Great Britain.

Col. Ashley, in reply, said that the development of the supply of electricity in rural areas in Sweden had been brought to his notice. The question of simplifying and cheapening the construction of overhead-line distribution systems in this country had been receiving the attention of all parties concerned. Revised regulations which would, he hoped, assist this end, were being issued this week by the Electricity Commissioners, who were also in communication with the Postmaster-General with regard to certain aspects of the matter.

Electro-Therapeutic Treatment.

On April 19th, Captain Fraser asked the Minister of Health if, in view of the value of massage and electro-therapeutic treatments in hastening the return to physical fitness of persons who suffered from accident or disease, causing loss of time or efficiency in industry, he would consider making those treatments an additional benefit in National Health Insurance.

Mr. Chamberlain said that in the National Health Insurance Bill now before the House, provision was made for the inclusion in the list of additional benefits of a new benefit under which approved societies would be able to make payments towards the cost of massage and electro-therapeutic treatment of their members in approved institutions.

Broadcasting.

On April 19th, Sir W. Mitchell-Thomson informed Sir Charles Wilson that he had received no application from the British Broadcasting Corporation for permission to proceed with the erection of a regional station in the North.

Legal.

Claim for Wireless Set.

In the Shoreditch County Court, on April 17th, before Judge Cluer, Mr. W. A. Springall, Clapton, N.E., radio manufacturer and dealer, sued Mr. Mackenzie, Clapton, to recover £6 6s. 6d. in respect of a six-valve wireless set. There was a counter-claim for £3 7s. for work that had to be done on the set, and the replacing of the six valves, which, it was alleged, the defendant spoilt and rendered valueless.

The plaintiff said that the defendant brought him a blue print of the set that he wanted built, and supplied him with the fittings. He finished the work and the defendant expressed satisfaction with it, but although he had repeatedly asked for the money, he had been unable to obtain it, and it was not until he sued defendant that it was claimed that the work was not properly done. In cross-examination, he admitted that the wireless set was built for a 2-V accumulator, and that his was a 6-V accumulator. He did not know that the defendant was alleging that he had called to say that the 6-V accumulator had been used and burnt the valves out, or that the defendant had taken the set to the General Electric Co., Ltd., which had supplied the parts, to have it put right. At his place it worked quite satisfactorily.

The Judge said that as the case was a highly technical one, the matter would have to stand adjourned.

British Thomson-Houston Co., Ltd., v. Coldwell & Davy.

In asking Mr. Justice Astbury, in the Chancery Division on April 20th, for an interim injunction in connection with the British Thomson-Houston Co.'s patents for gasfilled electric lamps and leading-in wires, Mr. Trevor Watson said that the circumstances were unusual because the motion for injunction was directed against two persons—J. Coldwell and W. Davy, both of Leeds, and injunctions had already been granted. The present injunction sought was against parting with gasfilled lamps said to be infringements. The plaintiffs obtained an *ex-parte* injunction against Davy, who thereupon took the lamps which were on his premises to a man named Coldwell, and to prevent Coldwell parting with the lamps the plaintiffs brought an action, and Mr. Justice Clauson granted an *ex-parte* injunction, but said it was desirable that Davy should be joined in the action.

The object of the action was to enable the plaintiffs to get possession of the lamps, following up a judgment they had already got for infringement.

Mr. Justice Astbury made the order asked for.

Fraudulent Use of Electricity.

At Middleton (Lancs.) on April 16th, Alfred Mellor, deputy borough treasurer of Middleton, was charged with the fraudulent use of electricity in that he obtained a supply for a reading lamp from the power circuit. The defendant at first pleaded "Not guilty," but later altered his plea to "Guilty." He said that he had only used a very small quantity of electricity and plugged the lamp into the power circuit for convenience. The magistrates imposed a fine of £25, with costs.

Reviews.

Commercial Electrical Measuring Instruments. By R. M. Archer, B.Sc., A.R.C.Sc., M.I.E.E. Pp. xvi+259; figs. 74. London: Sir Isaac Pitman & Sons, Ltd. 1928. Price 10s. 6d. net.

This book is intended to be an introductory treatment of the subject of commercial measuring instruments, for the use of those desirous of obtaining a general idea of the construction and basic principles of such instruments, without concerning themselves to any extent with considerations of advanced theory. The author assumes that his readers have a knowledge of elementary mathematics and electrical theory, but, in spite of this assumption, a good deal of the somewhat limited space at his disposal is taken up with lengthy discussions of points of elementary theory which are adequately dealt with in the usual text-books. The discussion on p. 152 of the meaning of the heating value of a direct current appears to be entirely frivolous, and an attempt to create a difficulty which does not exist. On the other hand, as easy elementary proofs of the mean and virtual values of alternating quantities are available, it is surprising that the reader is asked to take these values on trust. The lack of any reference to instrument transformers is very regrettable. In fact, the treatment of alternating-current measurements is generally meagre and scanty, no space, for instance, having been devoted to the subject of polyphase power determination. In view of the tacit convention which excludes integrating meters from the general designation "instruments," it is hardly necessary to say that such meters are not treated of in this book. The portions of the work dealing with instruments for use on direct-current circuits is generally very sound, and the author has given a very good account of the construction and principles of these instruments, which will appeal to the engineer whose interest in the subject is of a more or less passing character. For the benefit of those desiring to pursue their studies on this subject a very good list of references to other works and original papers is given.

After an introductory chapter dealing with the application of basic electrical principles to electrical measurements, the author deals with moving-iron instruments. Chapters dealing with the subjects of screening and damping precede a very good and full treatment of the permanent-magnet moving-coil instrument. Dynamometer, hot-wire, and electrostatic instrument are next considered, and a short chapter then follows on simple tests with direct-current ammeters and voltmeters. The chapter on alternating-current, voltage, and power measurements is mainly devoted to a discussion of basic principles, and, whilst reference is made to the obsolete Sumpner wattmeter, no mention is made of the induction type of instrument so widely used. A short chapter deals with induction a.c. ammeters and voltmeters, and the author has given a very clear account of the working of these instruments, on popular lines. Two chapters on the operating characteristics of instruments, and on the selection of instruments for given duty are most useful, and abound in practical information. The final chapters deal somewhat superficially with graphic recorders, and such miscellaneous instruments as tachometers, pyrometers, instruments for radio frequencies, and test sets.

The book contains a number of tables giving valuable data regarding instruments, and materials used in their construction. There is a good index, and a list of illustrations. The work will be found generally acceptable by the class of readers for which it has been written.

Principles of Electric Power Transmission. By H. Waddicor. Pp. xix+399; figs. 148. London: Chapman and Hall, Ltd. Price 21s. net.

In pursuing a course of study in electric power transmission at a university or technical college, it would seem perfectly obvious that all the necessary mathematics and fundamentals of the subject would be taught, and, as everybody can, at the trade price, obtain the world's best electric power transmission and allied literature, it is also obvious that the best literature will be found in the library of each university and technical college, and made available to students. The electrical aspect of this subject has already been covered over and over again.

There would seem to be no end of book making. There are good books and bad books; books worth more than their weight in gold, and books only fit for the waste-basket; and there are all grades of books coming between these extremes and varying all the way from original material of the highest quality down to useless matter likely to prove dangerous. There are books showing old matter presented in new clothes, also books compiled entirely from existing publications and catalogues, some of merit and others very doubtful. There are far too many books of the latter kinds, and of those where the writer will insistently follow heredity. Some use can be made of these latter types of books when something new or novel is presented, either in theoretical or practical form, offering advantages over the old and commonly known methods and matter.

According to the preface of the book it is stated quite frankly that nothing novel is presented, but the author claims that the book is a systematic exposition of the principles under-

lying the electrical design of transmission lines, and contains results given in a scattered literature. There certainly is a vast amount of valuable and general literature in the market from which writers can choose; not unlike a painting, a copy is usually inferior. The author has drawn very largely from American literature.

The book contains 391 pages of written matter, the contents are well arranged, the long list of symbols are well described, and the index, which covers six full pages, is well prepared. At the end of each chapter references are made to literature drawn upon. The book is of the standard Chapman & Hall 21s. size.

Electric Wiring, Fittings, Switches and Lamps. Sixth Edition. By W. PERREN MAYCOCK, M.I.E.E., revised by PHILIP KEMP, M.Sc., M.I.E.E. Pp. viii+638; figs. 628. London: Sir Isaac Pitman & Sons, Ltd. 1928. Price 10s. 6d. net.

In revising this well-known book for the sixth edition, Mr. Kemp has left the general plan unaltered, and has confined his work to the supercession of obsolete matter, by new matter covering progress which has taken place in the field covered by the title, since the publication of the last edition in 1917. Although the title page of the book states that it is for the use of electric light engineers, contractors, consulting engineers, architects, builders, wiremen, and students, the general treatment is of the well-known popular character, with which the late Mr. Maycock was so successful, and the work is really most suitable for the uninstructed beginner in electrical matters. A large amount of space is devoted to the subject of special switch circuits, and this results in an inordinate amount of space being given to the products of one particular firm. The space allocated to wiring systems is by no means excessive in a work of this character, and we have been able to find no reference to those systems which use a bare earth wire within and in contact with the metallic sheath. Although the necessity for bonding and earthing is adequately stressed, we consider that a somewhat full explanation, on popular lines, of the necessity for this precaution would have been very useful. There appears to be no specific reference in the book to the use of cab tire sheathed cables for surface unprotected wiring.

The book is furnished with an index, and a list of questions is appended to each chapter. We wish that it had been possible to have recast the index so that the references were to pages and not to paragraphs. The reader is inclined to feel some irritation when the index refers him to such a paragraph as No. 97, which covers no fewer than 25 pages.

Practical Radio Telegraphy. By ARTHUR R. NILSON and J. L. HORNUNG. Pp. ix+380; figs. 283. London: McGraw Hill Publishing Company, Ltd. Price 15s. net.

This book is intended for students who wish to qualify for the marine wireless operator's licence in the United States of America. The installations described are therefore rather outside the field of knowledge required for the corresponding operator's certificate in this country, but all the general matter in the book is appropriate to the syllabus for our operators' examination. The book assumes no previous knowledge of the principles of electricity and no mathematical knowledge beyond simple equations. It deals essentially with the elementary theory and practical working of marine wireless as it is to-day in the mercantile service of the U.S.A., and does not touch on those developments which are just beginning to enter the commercial sphere so far as ships' communications are concerned, *e.g.*, short waves and telephony, a knowledge of which is not yet required from marine operators. It deals adequately with those developments which have recently been established commercially, *e.g.*, continuous wave working and direction finding. The theoretical portions of the book are clear and simple, and cover the necessary ground. A series of examination questions follows each chapter and a general index is included.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1926.

32,843. "Reproduction of talking-machine records by electrical means." P. J. C. Wheeler. December 21st, 1926. (287,954.)

32,579. "Telegraphy." W. S. Smith, N. W. McLachlan, and W. G. R. Jacob. December 23rd, 1926. (287,956.)

32,690. "Electric switches for use on motor vehicles." E. W. Parrish. December 24th, 1926. (287,957.)

32,713. "Circuit arrangements and discharge tubes for amplifying electric oscillations." H. Wade (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). December 24th, 1926. (287,958.)

32,947. "Recovery of reaction products from gases treated with electric arcs." I. G. Farbenindustrie Akt.-Ges. December 30th, 1925. (263,859.)

32,975. "Light signals." Westinghouse Brake & Saxby Signal Co., Ltd. August 13th, 1926. (275,925.)

1927.

79. "High-frequency signalling systems." Standard Telephones & Cables, Ltd. (Western Electric Co., Inc.). January 1st, 1927. (Cognate application 169/27.) (287,972.)

165. "Telephone systems." Reserve Holding Co. January 9th, 1926. (264,154.)

438. "Electric contact devices." Siemens Bros. & Co., Ltd., and L. G. Salmon. January 6th, 1927. (287,975.)

1,031. "Electric flashlight photographic camera." W. Murray. July 23rd, 1927. (287,981.)

1,124. "Automatic or semi-automatic telephone systems." Coventry Automatic Telephones, Ltd., and B. F. Moss. January 14th, 1927. (287,983.)

1,882. "Electric buzzers and interrupters." A. C. Brockies. January 21st, 1927. (287,986.)

1,883. "Electric relays." A. C. Brockies. January 21st, 1927. (287,987.)

2,395. "Automatic starting and stopping of electric motors." Drysdale and Co., Ltd., and W. Drysdale. January 27th, 1927. (287,990.)

2,678. "Electric clocks." R. J. M. Lowne and B. T. Lowne. January 29th, 1927. (287,991.)

4,168. "Electric fires." R. P. Roberts and P. Hodson. February 15th, 1927. (Cognate applications, 8,065/27, 8,409/27, and 13,888/27.) (288,000.)

4,271. "Telephone exchange components." Sterling Telephone and Electric Co., Ltd., N. Blades, and J. R. Beard. February 15th, 1927. (288,001.)

4,692. "Means for forming and attaching the metal connecting bars or the like of electric battery or accumulator plates." G. H. Trotter. February 19th, 1927. (288,005.)

5,506. "Appliance for the application of radiant energy in the form of ultra-violet light." Kelvin, Bottomley & Baird, Ltd., F. A. King, and A. A. King. February 28th, 1927. (Addition to 266,489.) (288,007.)

7,335. "Telephonic receivers." W. J. Rickets, J. D. Dunthorne, and A. C. Brockies. March 16th, 1927. (288,019.)

9,568. "Electric lampholder." G. W. Hawker. April 7th, 1927. (288,029.)

10,717. "Sparking plugs for internal-combustion engines." F. Moser. April 21st, 1927. (288,035.)

10,943. "Electric heating apparatus." Measurement, Ltd., and G. Melville. April 23rd, 1927. (288,036.)

11,055. "Electric cooking apparatus." S. Thompson. April 25th, 1927. (288,037.)

13,277. "Selective relays for the protection of electric distribution systems." Compagnie pour la Fabrication des Compteurs et Materiel d'Usines a Gaz. January 29th, 1927. (Patent of addition not granted.) (284,304.)

14,986. "Cove and other lighting systems." P. M. Hotchkin. June 7th, 1927. (288,053.)

15,170. "Recovery of reaction products from gases treated with electric arcs." I. G. Farbenindustrie Akt.-Ges. December 30th, 1926. (Divided application to 263,859.) (Addition to 263,859.) (288,056.)

15,196. "High-speed telegraphy." Etablissements E. Belin. June 4th, 1926. (272,250.)

16,882. "Apparatus for supplying electric current to valves used for wireless telegraphy." Soc. Anon. des Accumulateurs Monoplaque. October 6th, 1926. (278,670.)

17,829. "Electric motors using a frequency transformer as source of current." H. Schneider. December 21st, 1926. (282,625.)

17,846. "Electric devices for securing uniformity in slivers or the like in preparing or spinning machinery." G. Heintze. July 5th, 1927. (288,068.)

17,938. "Electric regulators." Electrical Research Products, Inc. August 4th, 1926. (275,582.)

19,251. "Methods for the synchronisation of picture telegraphs, telautographs and the like." C. Lorenz Akt.-Ges. August 3rd, 1926. (275,594.)

21,186. "Frame aerials for use in wireless telegraphy and telephony." E. A. O. Viel and J. Amiot. August 11th, 1926. (276,002.)

21,287. "Automatic starter for induction motors." J. Sousedik. September 6th, 1926. (276,974.)

21,499. "Resistance elements and method of assembling the same." H. E. Campbell. August 15th 1927. (288,082.)

23,422. "Crystal holders more particularly for piezo-electric frequency control." Westinghouse Electric and Manufacturing Co. September 13th, 1926. (277,330.)

24,592. "Electric imitation coal fires." C. W. Denny. September 19th, 1927. (288,090.)

25,506. "Means for mounting measuring instruments and switch devices on motor vehicles." Ota Apparate-Ges. September 27th, 1926. (278,021.)

25,821. "Electrically-heated bakers' ovens." H. H. F. Danger and O. Danger (trading as H. Danger (firm of)). October 22nd, 1926. (279,416.)

26,068. "Interlocking systems for railways." General Railway Signal Co. October 5th, 1926 (278,706.)

26,722. "Electrical insulators." J. E. Pollak (Hermsdorf-Schomburg Isolatoren Ges.). October 8th, 1927. (288,093.)

27,297. "Electric motor-starting switches." British Thomson-Houston Co., Ltd. October 21st, 1926. (279 438.)

27,805. "Medical electric lamps." Baron Clifford of Chudleigh (W. H. Clifford). October 14th, 1927. (288,160.)

27,816. "Electric heating elements." Naamlooze Vennootschap Technisch Handels-Bureau Thabur. October 19th, 1926. (279,464.)

29,277. "Electrical condensers." Dubilier Condenser Co. (1925), Ltd. November 23rd, 1926. (281 246.)

30,576. "Lead-cable presses." F. Krupp Grusonwerk Akt.-Ges. March 15th, 1927. (287,099.)

30,907. "Transformers." British Thomson-Houston Co., Ltd. November 18th, 1926. (280,932.)

32,580. "Means for compensating the forces in voltage regulators." Naamlooze Vennootschap Machinerieven en Apparaten Fabrieken. December 16th, 1926. (Addition to 252,729.) (282,374.)

33,838. "Apparatus for photographically recording sound and for reproducing sound from a record thereof." British Thomson-Houston Co., Ltd. December 22nd, 1926. (282,661.)

33,996. "Electric switch for preventing the theft of automobiles." Compagnie D'applications Mecaniques. April 3rd, 1926. (Divided application 7,813/27.) (282,423.)

1928.

6,237. "Insulators." British Thomson-Houston Co., Ltd. March 2nd, 1927. (286,270.)

Trade Mark Applications.

THE following are among the recent applications for British patents. Objections against any of the proposed marks may be entered within one month from April 18th:—

Faithful Service (lettering and design). No. 486,936. Class 8. Electric batteries and accumulators.—Oldham & Sons, Ltd., Denton, Manchester.

Insol. No. 488,098. Class 8. Fixed condensers.—Louis Holzman, 34, Kingsway, W.C.2.

Arrow (lettering and design). No. 488,511. All goods in Class 8.—Parlophone Co., Ltd., 1, Broad Street Place, E.C.2.

Tannoy. No. 488,958. Class 8. Electrical instruments and apparatus for use in connection with radio-telegraphy and telephony.—G. R. Fountain, trading as the Tulsemere Manufacturing Co., Tulsemere Road, West Norwood, S.E.27.

Lectrapads (lettering and design). No. 488,719. Class 11. Electric batteries (medical) for the treatment of the human foot.—Paul Roullier & Co., 44, Tachbrook Street, S.W.1.

Nitra. No. 483,017. Class 13. Electric lamps (ordinary).—Osram Gesellschaft, Berlin. (British representatives: Edward Evans & Co., 27, Chancery Lane, W.C.2.).

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

AMPTHILL.—Housing scheme (24), for the R.D.C.; Leonard Foster, surveyor, Flitwick, Bedford (returnable deposit of £1 1s.).

ATHERSTONE.—70 houses, Westwood Estate; R.D.C. surveyor.

BARNES (Surrey).—Motor showrooms and flats, for E. Hunt; R. B. Rowell, architect.

BARNSLEY.—150 houses by direct labour; borough engineer. Warehouse extension, Summer Lane; Barnsley British Co-operative Society, Ltd.

BEDFORD.—Extension, casual wards, Kimbolton Road; E. H. C. Inskip, for Board of Guardians.

BLYTH.—Public hall; Special Corporation Committee.

BOURNEMOUTH.—Alterations, South Western Hotel, Holdenhurst Road; Eldridge, Pope & Co., Ltd. Alterations, *Echo* office, Albert Road; Southern Newspapers, Ltd.

BRADFORD.—Elementary and secondary schools, Swain House Estate; Education Committee.

BRIGHTON.—Library extensions; H. D. Roberts, borough librarian.

BRISTOL.—24 houses, Brooklyn Road, Bedminster; W. J. Kew.

BROOKWOOD.—Conversion of farmhouse at asylum for patients; Surrey county architect.

BURY.—Housing scheme (32), East Ward (deposit £2); J. A. Settle, borough engineer.

CARLISLE.—Improvement scheme, Carlisle Arms, English Street (£53,000); city engineer.

CARSHALTON.—Houses (90), Nibloc Syndicate. Extensions, Children's Hospital (£200,000), for the Metropolitan Asylums Board; clerk.

CASTLE-DOUGLAS.—Re-erection of portion of Mollance (mansion), for John Neilson (£30,000).

CHERTSEY.—Housing scheme (100), for the U.D.C.; surveyor.

CHESTERFIELD.—Extensions, Nurses' Home, for the B.G.; W. A. Derbyshire, architect, 30, Gluman Gate (returnable deposit of £1 1s.).

CONWAY.—Additional 80 houses for the T.C.; borough surveyor.

DERBYSHIRE.—Reception hospital with X-ray room, lighting and heating (£52,102), for the C.C.; G. H. Widdows, architect, Derby; Evans Bros. & Co., builders, Riddings.

DRAYCOTT.—Isolation hospital extensions, including nurses' home, cubicle block, &c., for Shardlow Joint Hospital Committee; F. S. Antliff & Son, architects, Draycott, Derby (returnable deposit of £2 2s.).

FAIR OAK (Hants).—Mental hospital; Corporations of Portsmouth, Southampton, and Bournemouth.

FIFE.—Block alterations and extensions at laundry, &c., at West of Fife Infectious Diseases Hospital (£19,350) (electric lighting); Muirhead & Rutherford, architects, Dunfermline.

GLASGOW.—Roman Catholic church at Knightswood; the Archbishop. Church halls at Braidfauld Road; Rev. David A. Millar. Additions to church for Kelvinside United Free Church; the minister.

GRANTHAM.—Additional 56 houses for the T.C.; borough surveyor.

GRAVESEND.—Additional housing scheme (180), for the T.C.; housing architect.

GUILDFORD.—Extensions, Museum; Norris & Shattock, architects.

HAMILTON.—Business stores with offices and houses, for the Co-operative Society; secretary.

HARROW WEALD.—Central school; Middlesex Education Committee.

HASTINGS.—Bank, London Road; Westminster Bank, Ltd.

HAWICK.—Extension of the Cottage Hospital; secretary.

HULL.—Extensions, Royal Infirmary, including nurses' home and additions to X-ray department (£24,000), for Board of Management; secretary.

IRISH FREE STATE (Dublin).—Daylight system of electric lighting at Municipal Art Gallery; City Commissioners.

(Drumcondra, Dublin).—Electric lighting and heating of 100 houses for the City Commissioners; G. J. Sherlock, town clerk, Exchange Buildings, Lord Edward Street.

(Rathmines, Co. Dublin).—Electrical work at Isolation Hospital at Clonskeagh; S. Mason, clerk to Rathmines and Pembroke Joint Hospital Board, Town Hall.

IRISH FREE STATE—(*Continued*).—

(Tourmakeady, Co. Mayo).—Training college for the Commissioners of Public Works, Dublin; T. Cassidy, secretary, Public Works Offices, Dublin.

JARROW.—Rebuilding scheme, Poets Corner (£39,000); borough surveyor.

LEEDS.—Hospital for surgical tuberculosis, Elmet Hall Estate; Medical Officer of Health. 158 houses, York Road and Selby Road Estates; W. J. & R. Turnbull. 86 houses, Middleton Estate; F. Clough. 100 houses, Meanwood Estate; W. Thompson & Sons. Consulate premises, Guildford Street; American Consul. New Baptist church, Harehills Lane; Herbert J. Manchip, architect, 49, Windermere Road, Muswell Hill, London, N.10 (£2 2s. deposit).

LINCOLN.—Junior school (£10,000), for the E.C.; director of education.

LONDON (Finchley, N.).—Pumping station, Broughton Avenue (£5,500); H. Potter.

(Southwark, S.E.).—Alterations, 7-13, Lavington Street; F. A. Saunders & Co., Ltd.

(Kensington, S.W.).—Library extensions (£4,000); borough engineer. Tenements, Blomfields Yard; Kensington Housing Trust, Ltd.

(St. Marylebone, W.).—Buildings, 508-510, Edgware Road; Hall-Jones & Dewhurst.

LOWESTOFT.—Smallpox hospital; Corporation and County Council.

MAIDSTONE.—Church hall, Mangravet Estate; T. F. W. Grant, architect, 11, Buckingham Street, Adelphi, W.C. (returnable deposit of £1 1s.).

MANCHESTER.—1,404 houses, Barlow Moor; city architect.

NANTWICH.—Additional 40 houses for the R.D.C.; surveyor.

NEW MILLS.—Housing scheme (50), Bakehurst Estate; W. C. Sheard, surveyor to U.D.C.

NORTHWICH.—Central school; Cheshire Education Committee.

OXFORD.—Corn and hay stores, Abingdon Road; H. C. Wiggins. Development, Chilswell Estate; New College governors. 9 shops, Albert Road, Summerton; G. Simmons.

PAIGNTON.—44 houses, Tweenways Lane; Unity Builders (Paignton), Ltd.

PORTSMOUTH.—Shop and flats, Kingston Cross; Geo. Peters & Co., Ltd. 20 houses, Target Road; McCormick and Son. Hall and offices, 226-230 Fratton Road; Ancient Order of Foresters.

PRESTWICH.—Catholic church, Fairfax Road; Rev. Father Browne.

REIGATE.—Housing scheme (26), for the R.D.C.; surveyor, 48, High Street (returnable deposit of £3 3s.).

SALE.—Extension of High School for Girls; Cheshire Education Committee.

SHIREHAMPTON (Bristol).—Church, with heating and lighting (£16,000); Hartland Thomas, diocesan surveyor.

SMETHWICK.—Development Old Chapel Estate (£45,000); borough engineer.

SOUTH MOLTON (Devon).—Housing scheme (60), for the R.D.C.; surveyor.

SOUTHEND-ON-SEA.—New St. Augustine's Church, Thorpe Bay (£11,000), with heating and lighting; H. W. Allardyce, architect. Intermediate school (£23,069), for the Borough E.C.; F. Hutton & Sons, builders, Colchester.

STIRLING.—Police station, with electrical and heating work, for the T.C.; A. H. Goudie, burgh engineer.

SWANSEA.—Central school, Morriston; Education Committee. 100 houses by direct labour, Mayhill and Townhill Estates; borough engineer.

SWINDON.—Police station, Gorse Hill (£15,495), for Wilts. C.C.; Blackford & Son, builders, Calne.

TROWBRIDGE.—Hospital; A. J. Taylor, Bright Street, Bath, and W. W. Smailum, Trowbridge, architects (returnable deposit of £1 1s.).

TRURO.—Additional 20 houses, for the T.C.; borough surveyor.

WAKEFIELD.—Congregational Church, Lupset Estate; Congregational Union. Primitive Methodist church, Snapethorpe Estate; Methodist trustees.

WARWICK.—Re-erection of portion of gelatine works, electrically equipped, for Nelson, Dale & Co.

WESTON-SUPER-MARE.—Roman Catholic church; Rev. Canon J. Lyons. Bank premises, Lloyd's Bank, Ltd.

WOKINGHAM.—Housing scheme (46), for the R.D.C.; surveyor.

WORCESTER.—Nurses' home (£12,000), for the B.G.; E. G. Jones and G. R. Acton, architects; A. H. Guest, Ltd., builders.